MAGAZINE
OF
SCIENCE.

D. FRANCIS, STEPNEY PRESS,
WHITE HORSE LANE, MILE END ROAD.

THE

MAGAZINE OF SCIENCE,

AND

SCHOOL OF ARTS:

INTENDED TO ILLUSTRATE THE MOST USEFUL, NOVEL, AND INTERESTING PARTS

OF

NATURAL HISTORY AND EXPERIMENTAL PHILOSOPHY,

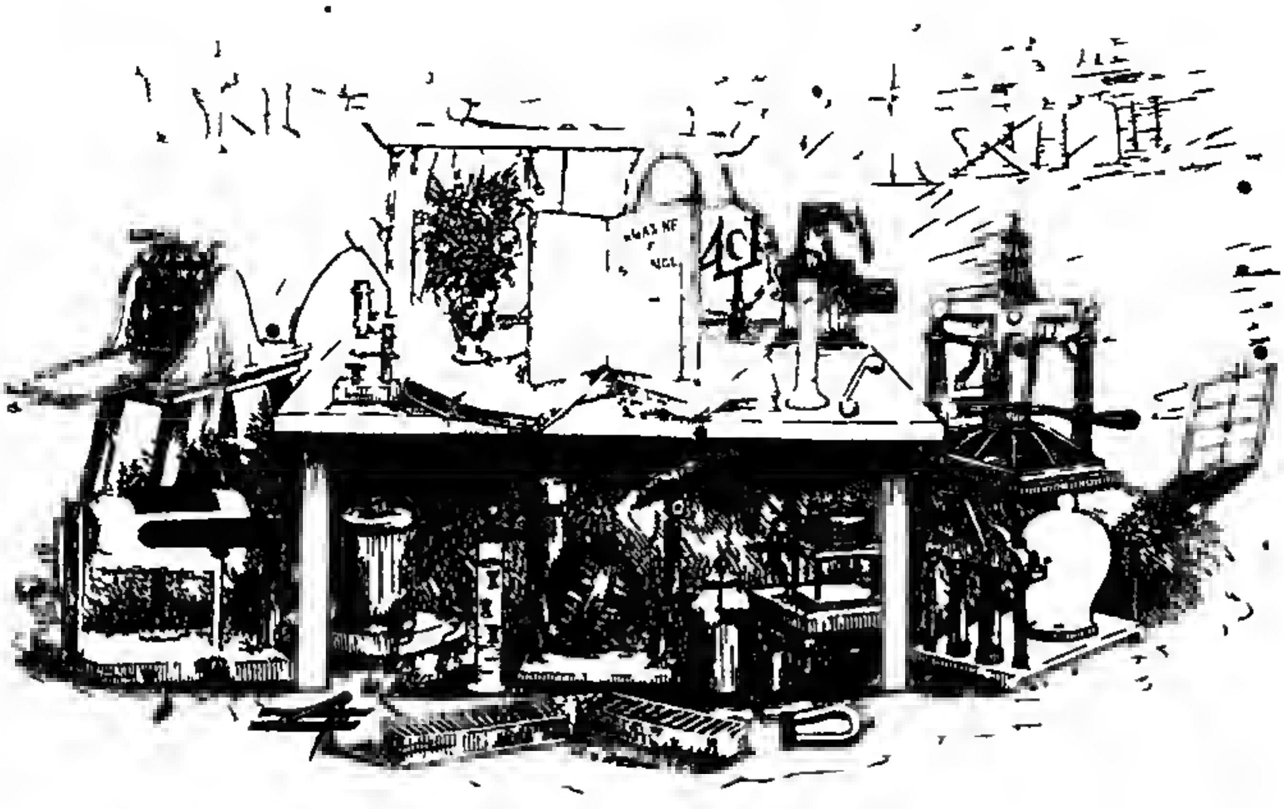
ARTISTICAL PROCESSES,

ORNAMENTAL MANUFACTURES, AND THE ARTS OF LIFE

EDITED BY

G. FRANCIS, F.L.S.

[illegible] [illegible]ONARY OF ARTS AND SCIENCES, CHEMICAL EXPERIMENTS, ELECTRICAL EXPERIMENTS, ART OF [illegible] WAXEN FLOWERS, ETC. ETC.



VOL. I.

New and Improved Edition.

ILLUSTRATED WITH UPWARDS OF TWO HUNDRED ENGRAVINGS

London:

D. FRANCIS, 21, MILE END ROAD, J. ALLEN, WARWICK LANE, E. WARD, 54, PATERNOSTER ROW, AND ALL BOOKSELLERS

1849.

PREFACE.

(TO THE FIRST EDITION.)

OUR Editorial labors for the first year are now concluded, and it is with some gratification, that we complete this, the first volume of

THE MAGAZINE OF SCIENCE AND SCHOOL OF ARTS.

We began by a plain, straight-forward statement, *(see page 1,)* of our object and intentions, determined to act up to them to the best of our ability. We have done so, and can boldly appeal to our friends and constant readers—whether we have not exceeded our promises? We have recorded every thing new and valuable—explained numerous most important Philosophical Instruments—have ourselves written nearly Two Hundred Original Papers on Scientific Manipulation, or explanatory of interesting Processes, (some of which were never before made public)—have answered One Hundred and Seventy Queries, and conducted, we trust with courtesy and attention, an extensive Correspondence. If we have delayed for a week or two, at any time, to give the information sought after, it has been only because we were desirous, in the meantime, to search out the best and fullest information—thus, the request of a single receipt has often produced a full description—a hint has suggested an interesting process. Hence have arisen the papers on Gilding, Lackering, Bronzing, Medalling, and very many others; which, we flatter ourselves, are useful to all future inquirers. Had this plan not been adopted, our Magazine would have been "a thing of shreds and patches;" at present, however individual patience may have been tried, the general value of the volume has been greatly increased, for all is, as far as possible for us to have made it, fully perfect, complete, and instructive.

The above will easily account for the circumstance that so many scientific subjects have not hitherto been explained—Galvanism, Electro-Magnetic Action, Pneumatics, the Lucernal and Oxy-hydrogen Microscope, Polarization of Light, some departments of the Fine Arts, particularly the different styles of Engraving, Lithography, &c.—the subjects of Varnishing, Assaying, Botany, Geology, and numerous others. Some of these have been long prepared, and will be immediately entered into in the second volume. Science, indeed, offers so many experiments, affords so much delight, gives rise to such new and unlooked-for results, and contributes in so great a degree to improvement in the arts of life, locomotion, and commerce; besides giving us a rational, and extensive knowledge of the works of nature, that we can have no hesitation in promising still more valuable matter for our future pages than that which has gone before.

But it is somewhat irksome to record our own endeavours and our own anxiety; nor is it further necessary. The constantly and steadily-increasing sale of our work, week by week, and month by month, is our best reward. It has reached a degree of extension, not only above our most sanguine hopes, but which at first we believed impossible for any such a periodical to have done; which gives us the most encouraging expectations for the future—and which will excite us onwards in our useful course with renewed vigor, and we trust, having now greater experience, with renewed and increasing success.

It remains for us now only to return thanks to our very numerous Contributors, Subscribers, and Well-wishers, and this we do sincerely and heartily,—begging to assure them, that if we have not at all times followed their advice, attended to their requests, and inserted the contributions which they have been so kind as to send us, it has been because of circumstances, which we could not fully explain, not from a disregard toward them; for if we have had one endeavour more than another, it has been to treat all with equal respect and equal attention.

THE EDITOR.

55, *Great Prescot Street,*
April 1st, 1840.

PREFACE TO THE SECOND EDITION.

The sale of a volume of a Scientific Magazine, being so great as to warrant the expense of a large reprint, and still more so to justify the additional outlay of stereotyping, is unparalleled in the history of periodicals;—yet such has been the case with this volume. The proprietors have therefore taken the opportunity of having a careful revision of the whole, a uniform type preserved throughout, additional wood-cuts inserted where the text was obscure, the introduction of new and interesting matter, instead of answers to correspondents, advertisements, and other ephemeral notices, and such other improvements as have a tendency to promote uniformity, and add additional value to the whole series, which is now proceeding through the Third Volume.

THE EDITOR.

27, *Cottage Grove,*
August, 1841.

MAGAZINE OF SCIENCE AND SCHOOL OF ARTS.

THE increasing desire among all classes for rational and scientific amusement, induces the Proprietors to offer to the Public this cheap and useful publication.

The intention is three-fold. *First*,—to record, explain, and illustrate all useful discoveries made from time to time in the MECHANICAL and PHYSICAL SCIENCES, and to give full and accurate descriptions of all new and interesting PHILOSOPHICAL APPARATUS and EXPERIMENTS. Besides which, this part of the work will contain critical and popular Papers on every division of NATURAL PHILOSOPHY and CHEMISTRY, ELECTRICITY, GALVANISM, MAGNETISM, ELECTRO and THERMO-MAGNETISM, will meet with especial attention; and here we flatter ourselves we have some strength of experience and correspondence.

ASTRONOMY, particularly in the making of Illustrative Apparatus—an account of which is given in no work whatever.

OPTICS and OPTICAL INSTRUMENTS, with the recent improvements and discoveries in MICROSCOPIC SCIENCE, now of such paramount value in understanding the works of nature. That new and wonderful Science, the POLARIZATION OF LIGHT, will receive adequate illustration, as well as the valuable Sciences of MECHANICS, HYDROSTATICS, HYDRAULICS, and PNEUMATICS, with their application to Manufactures, to Locomotion, and to the Steam Engine.

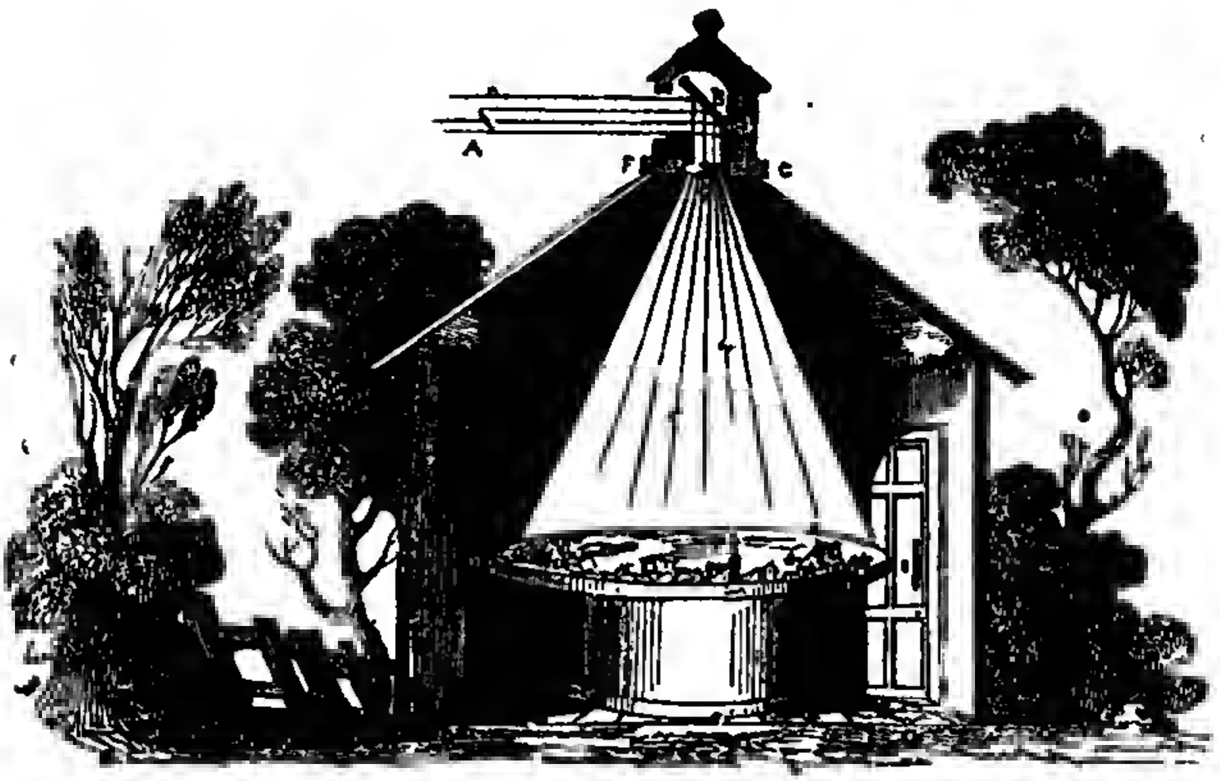
Secondly.—Our intention is to supply what we have long considered to be much wanted, a SCHOOL OF ARTS, or a manual of the processes of manufacture and of manipulation, employed in the Fine and Ornamental Arts, as well as in the more strictly scientific subjects. Thus we shall endeavour to give plain instructions to perform with success the Arts of METAL and WOOD ENGRAVING, MODELLING and CASTING, CARVING and ORNAMENTAL TURNING. The various styles of DRAWING and PAINTING—WORKING IN GLASS and JAPANNING—BUHL and MOTHER-OF-PEARL WORK, &c. &c.

NATURAL HISTORY, though forming no essential part of our plan, will not be wholly neglected. It will, indeed, be necessary to allude to many natural objects when treating of the Microscope. Also, the collecting, the preservation, &c., of ANIMALS and PLANTS, as well as the cleaning and beautifying SHELLS and MINERALS, will legitimately come within the class of the Ornamental Arts. Beyond this, we cannot at present, promise—unless, indeed, to give from time to time such short and incidental notices of the productions of our own country, as it may be useful for all to know, and which do not interfere with the more immediate objects of our Publication.

Thirdly.—To give a CRITICAL REVIEW of such New Publications on Science and Art, as fall under our notice, that the student shall have a guide to his choice of books, and that the stranger at a distance may learn what to purchase with advantage.

Thus we hope to enlist among our readers every class of persons. The gentleman who employs his leisure hours in works of genius or fancy, equally with the artizan who lives by his manual dexterity—the lecturer who explains the intricacies of science, and the student who is but entering its intricate paths—begging to assure them all, that what will be offered as original is mostly the result of long experience, and what is taken from others shall be only from the most authentic sources. We shall be especially solicitous that nothing trivial or incorrect be presented to our readers at any time; for, however much we may endeavour to render a subject familiar, (and this we always intend to do,) we shall still examine the mathematical principles upon which it depends, and the philosophical facts connected with it, and where tests like these cannot be applied, we shall endeavour to examine it by the still stronger rules of *common sense*.

But with all these good intentions our task will be difficult, unless we know the particular desires and deficiencies of our readers. We, therefore, solicit their communications, whether queries for their own information, or such answers to the difficulties of others as their own employments and tastes may have made them capable of removing. We also solicit their opinions and suggestions, and beg an early knowledge of their own discoveries, and information as to the discoveries of others; being well aware, that, although we have been promised every assistance from first-rate practical and scientific men, and intend actively to employ ourselves, to obtain for our readers the earliest information upon all matters of interest, yet without the co-operation of our general, and as yet unknown friends, much that is valuable must be lost.



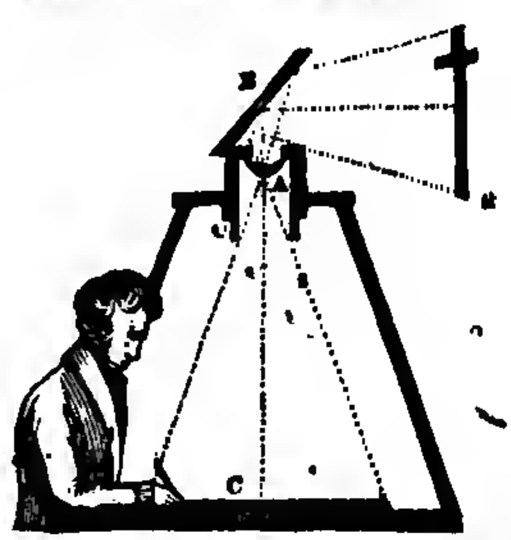
THE CAMERA OBSCURA.

This instrument, the object of the above engraving, and present description, was invented by Friar Bacon more than five hundred years ago. It is of such simple construction as to be easily understood, and represents the objects subjected to it in all their vivid colors, and with so unerring a fidelity, that it has always been a favorite amusement to view its varied and animating pictures. The following is an explanation of its construction:—

The engraving represents a room, into which the light penetrates only through the top at C. The rays of light A, tinged with the color of the objects reflected, pass through a hole in the side of the upper part of the instrument, and strike upon the looking-glass or reflector B, from this they are cast down upon the double convex lens C, fixed in the cross partition F G—here they diverge in proportion to the focus of the lens, and passing outwards are at last met by the white table below, D E, where the original objects are vividly depicted. The accuracy of proportion and truth of perspective will, however, not be ensured by a flat table, as will be evident upon considering that on a flat surface the rays of light passing through the lens will be shorter in the centre of the picture than those that reach the sides, (as is seen in the figure;) in consequence, the representation will be somewhat distorted, and also more brilliant towards the centre than near the circumference of the field of view. To remedy this, two methods suggest themselves; one, to have the table D E part of a hollow sphere of a radius according to the distance of the lens. This arrangement has a serious objection in delineating the objects represented, because of the impossibility of laying a sheet of paper on a spherical body. An alteration, therefore, of the lens itself is the only remaining resource; if this, instead of being *double convex*, be a *meniscus glass*, (that is, like a watch glass, thick in the middle,) having its concave side next the object, and if radii of the two surfaces be as 1 to 2, the outer rays will be rendered longer than those near the centre, and by this means the correctness and brilliancy of the picture will be greatly increased.

The upper part of the instrument is made to turn round upon a groove at F G, by which means the reflector may be directed to any side of the landscape; the reflector B is also moveable on a joint near the centre of its sides, like a dressing-glass, and thus it is made to reflect either distant or near objects. The hole in the side, at the top, may have a convex lens inserted in it, but although by this contrivance a larger field of view is obtained, brilliancy is lost in equal proportion.

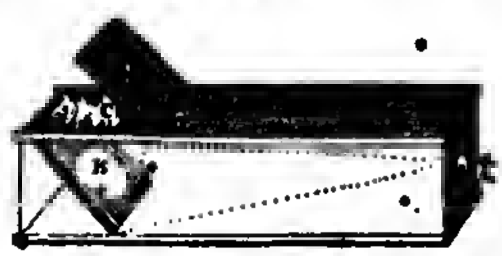
Portable Camera.—This instrument has many modifications: the above construction may be adapted to a large conical box, there being one hole or more cut in the side of it, to view the objects represented on the table within. A very convenient portable camera obscura for drawing landscapes or other objects is shown in the following figure,



where A is the meniscus with its concave side uppermost, and the radius of its convex surface being to the radius of its concave surface as 5 to 8, and B a plane metallic speculum, inclined at an angle of 45° to the horizon, to reflect the landscape downwards through the lens A. The draughtsman introduces his hand with the pencil through an opening in the side, made in such a manner as to allow no light to fall upon the picture, which is exhibited on the paper at C, a cloth covering over the man.

The tube containing the mirror and lens can be turned round by a rod within, and the inclination of the mirror changed, so as to introduce objects in any part of the horizon.

The Box Camera is still more portable, and may be constructed with yet greater facility, as follows:—Procure a box 12 inches long, 6 wide, and 4 deep. In the centre of one end place a lens, as before, (a common double convex lens, of about 10 inch focus, and which costs 6*d.*, will do very well,) and inside the box at the other end a piece of looking glass, at an angle of 45°, that is, half way between the vertical and the horizontal line, to reflect the objects upwards. That these may become visible, a part of the top of the box over the looking glass is cut away, and its place supplied with a piece of ground glass, the ground side to be placed uppermost. The instrument is now complete, except a blind or shield is required to keep extraneous light from falling upon the picture. This is effected easily, by the piece of wood which was removed from the top to make way for the glass being still suffered to remain suspended over it at a convenient distance.



In the above cut A is the lens, B the looking glass reflector, and C the plate of ground glass upon which the view is made apparent, and D the shield; the latter is capable of being moved up and down, to shut off as much light as may be advisable, and the lens is sometimes made to slide in a tube, in order that its focus may be better adjusted to the reflector, and that the objects depicted may be rendered as clear and vivid as possible. The action of the instrument will be easily understood; the light from the objects around is thrown upon A, they pass onwards to the reflector B, and are cast upwards to the lower side of C. This being transparent, they are seen on its upper side by a person looking into the instrument.

ELECTRICITY.

Electricity of all sciences has during the present century made most rapid strides, and stands pre-eminent in explaining the grander and more important universal phenomena of nature. It gives an explanation of the workings of a subtle and elastic fluid, called the electric fluid, which is distributed throughout all creation, remaining while at rest imperceptible to us, but when disturbed by mechanical friction, heat, or chemical action, producing all those effects called Electrical and Galvanic; perhaps Magnetic also.

The lightning, the Aurora Borealis, the water-spout, the whirlwind, the rolling pillars of sand of the desert, are but a few among the numerous effects of that powerful action of the fluid produced by friction, and which is usually called *free electricity; frictional electricity*; or *electricity of tension*, a science which from its first discovery has always been popular, not merely from its utility, but from the extreme beauty, and infinite variety of the experiments which illustrate it, most of which may be performed with but ordinary trouble, and at little danger or expense.

Singular it is that a universal fluid such as this, should not have been known to exist until about 200 years ago, yet electrical appearances were then first observed, and the more surprising, as there is scarcely an action we can do, and scarcely a motion of inanimate nature can take place, be it mechanical or chemical, which does not in some manner disturb the equilibrium of the electric fluid. The impinging of cloud upon cloud—the evaporation of moisture from the earth's surface—the fall of rain—the rolling of the ocean—are all stupendous electrical machines, and it requires only a concurrence of favorable circumstances to render the disturbance perceptible to one or more of our senses.

The proof of the universality of the fluid, and the facility of its disturbance will be evident by the following experiments, which are performed without the aid of a machine of any kind.

ON EXCITATION.

Ex. 1.—Take a piece of common brown paper, about the size of an octavo book, hold it before the fire till quite dry and hot, and draw it briskly under the arm several times, so as to rub it on both sides at once by the coat. The paper will now be found so powerfully electrical, that if placed against a wainscot or the papered wall of a room, it will remain there for some minutes without falling.

Ex. 2.—If while the paper remain fixed to the wall, a light fleecy feather be placed against it, it will adhere to the paper in the same way as the paper adheres to the wall.

Ex. 3.—If the paper be again warmed, excited, and hung up, a thread attached to one corner of it, it will hold up several feathers on each side; should these fall off from different sides at the same time, they will cling together very strongly, and if after a minute they be all shook off together, they will fly to one another in a most extraordinary manner.

Ex. 4.—Heat and excite the paper as before, lay it on a table, and place upon it a ball, about the size of a pea, made of elder pith; this ball will immediately run across the paper, and if a needle be pointed towards it, the ball will again travel to another part and so on for a considerable time.

Ex. 5.—Rub the end of a stick of common sealing wax, or a piece of amber, on the coat-sleeve, when it readily attracts from the table, bran, filaments of linen, minute scraps of paper, &c., and holds them suspended in the air.

Ex. 6.—Take two pieces of white paper, warm them at the fire, place them upon each other on a table or book, and rub strongly the upper paper with a piece of India rubber; the paper will now be found strongly electrical, so as to adhere together with such force that it requires some trouble to separate them, and when separated and then made to approach each other again, they will immediately rush together a second time. If they be separated from each other in the dark, a flash of electrical light will be seen between them, most frequently, accompanied with a cracking noise, which is the electric spark, and thus showing the electric fluid in sufficient quantity to be perceptible to the eye and ear.

Ex. 7.—Take two silk ribbons, one black, the other white, each about three feet long; warm them at the fire, holding them up flat against each other with one hand, and draw the thumb and fingers of the other hand briskly over them several times; they will thus become powerfully excited, and although the upper ends of the ribbons be forcibly separated,

to the distance of a foot or more, the lower ends will still cling together.

Ex. 8.—Another instance of electric repulsion is seen when a bunch of long hair is combed before a fire, "each particular hair will stand on end," and get as far as possible from its neighbour.

Ex. 9.—Support a pane of glass, (first warmed,) upon two books, one at each end—place some bran underneath it, and rub the upper side with a warm black silk handkerchief or a piece of flannel—the bran will now fly and dance up and down with much rapidity.

Obs.—In this way electric attraction was first discovered. A glazier, cleaning some window-sashes lying on a table, observed the small particles of whiting underneath to jump up and down; but it was long afterwards before the cause of this was known to be electrical.

(Continued on page 10.)

PNEUMATIC TELEGRAPH.

A PNEUMATIC telegraph has been invented by Mr. S. Crosley, an operative model of which is to be seen at the Polytechnic Institution, Regent Street. Atmospheric air is the conducting agent employed in its operation. The air is isolated by a tube extending from one station to another; each extremity of the tube being connected with a vessel containing a small volume of air in direct communication with the air in the tube. This vessel is employed as a reservoir to compensate for any increase or diminution which must necessarily arise from compression, or from changes in the temperature of the air, and for supplying any casual loss by leakage; the vessel must, therefore, be capable of enlargement and contraction in its capacity, after the manner of bellows, or as a gas-holder, by immersion in water, so as to maintain, uniformly, any particular degree of compression which may be given to it.

It will be evident to every one acquainted with the physical properties of atmospheric air, that if any certain degree of compression be produced and maintained in the reservoir, at one station, equilibrium will rapidly succeed, and the same degree of compression will extend to the opposite station, where it will become visible to an observer by means of a pressure index.

Thus, with ten weights, producing ten different degrees of compression, distinguished from each other numerically, and having a pressure index at the opposite station, marked by corresponding figures, any telegraphic numbers may be transmitted, referring in the usual way to a code of signals, which may be adapted to various purposes and to any language. The only manipulation is that of placing a weight of the required figure upon the collapsing vessel at either station, and the same figure will be represented by the index at the opposite station.

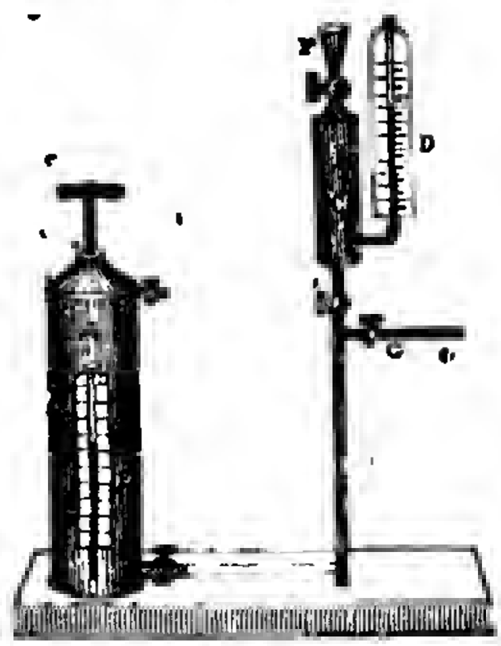
Previously to making a signal, the attention of the person, whose duty it is to observe it, is arrested by means of a preparatory signal.

The communication between one extremity and the other may be made known at intermediate stations, by connecting with the air tube indexes, corresponding with those at the extremities; but in order to avoid the necessity for additional sounding apparatus, which would retard the communications between the extremities, it would be necessary to limit such intermediate communications to stated periods, so that an observer might be in attendance.

A trial was made with a tube of one inch in diameter, very nearly two miles in length, returning upon itself, so that both ends of the tube were brought to one place:—the compression applied at one end, was equal to a column of seven inches of water; and the effect on the index at the other end appeared in fifteen seconds of time.

Laws have been propounded by eminent men on the expenditure of aeriform fluids through conduit pipes, and of the resistance of the pipes; but these are not strictly applicable to the present question. Under all circumstances, it seems desirable experiments on a practical scale, at extended distances, should be resorted to, as the most satisfactory guide, for carrying into effect telegraphic communications of this kind.

The following is a representation of the instrument of Mr. Crosley, which will be easily understood from the above description.



A is a cylinder of air at one extremity of the line, C is supposed to be a distant station, B the tube which connects these places, D the index at one of the stations; each cylinder or air vessel contains a little water, with a pipe below the surface of it. When the air at one end is compressed, the compression extends equally throughout the whole extent of the instrument, and pressing upon the surface of the water, raises it in the gages or index tubes equally at all the stations; these being numbered, and the numbers made representative of certain previously arranged signals, indication is of course readily communicated. F is a funnel to supply the water, to produce the proper adjustment at first, and also if it should become incorrect by leakage or accident. G a pipe leading to a further station, capable of being acted upon at the same time as the second, or by a cock each may be shut off as required.—*Phil. Mag.*

THE NOVEMBER METEORS.

SHOOTING stars and meteors burst from the clear azure sky, and darting along the heavens, are extinguished without leaving any residuum, except a vapour-like smoke, and generally without noise. Their parallax shows them to be very high in the atmosphere, sometimes even beyond its supposed limit, and the direction of their motion is for the most part diametrically opposit to the motion of the earth in its orbit. The astonishing multitudes of shooting stars and fire balls that have appeared

within these few years, et etated periods, over the American continent, and other parts of the globe, warrant the conclusion thet there are myriads of bodies revolving in gronps round the sun, which only become visihle when inflamed by entering our atmosphere.

One of these gronps seems to meet the earth in its annual revolution on the 12th and 13th of November. Several very remarkable instances have occurred.

On the morning of the 12th of November, 1799, thousands of shooting etars, mixed with large meteors, illuminated the heavens for many hours over the whole continent of America, from Brazil to Labrador; it extended to Greenland and even Germany. Meteoric showers were seen off the coast of Spain, and in tbe Obio country, on the morning of the 13th of November, 1831: and during many hours on the morning of 13tb of November, 1832, prodigious multitudes of shooting stars and meteors fell at Mocha on the Red Sea, in the Atlantic, in Switzerland, and et many places in England. But by much the most splendid meteoric shower on record began at nine o'clock in the evening of the 12th of Novemher, 1833, and lasted till sunrise next morning. It extended from Niagara and the northern lakes of America to the south of Jamaica, and from 61 degrees of longitude ln the Atlantic to 100 degrees of longitude in central Mexico. Shooting stars and meteors, of the apparent size of Jupiter, Venus, and even the full moon, darted in myriads towards the horizon, as if every star in the heavens had started from its sphere. They are descrihed as having been frequent as flakes of enow in a snow storm, and to have been seen with equal brilliancy over the greater part of the continent of North America.

Those who witnessed this grand spectacle were surprised to see that every one of the luminous bodies, without exception, moved in lines which converged to one point in the heavens: none of them started from that point; but their paths, when traced backwards, met in it like rays in e focus, and the menner of their fall sbowed that they descended from it in nearly parallel straight lines towards the earth.

By far the most extraordinary pert of the whole phenomenon is, that this rediant point was observed to remain stationary near one of the stars of the Lion for more than two hours and a half, which proved the source of the meteoric shower to be altogether independent of tbe earth's rotation, and its parallax showed it to be far above the atmosphere.

As a body could not be actually et rest in that position, the group must either have been moving round the earth or the sun. Had it been moving round tbe earth, the conrse of the meteors would have been tangential to its surface, whereas they fell almost perpendicularly, so that the earth in its annual revolntion must have met with the group. The bodies that were nearest must have been attracted towards the earth by its gravity, and as they were estimated to move at the rate of fourteen miles in e second, they mnst have taken fire on entering our atmosphere, and been consumed in their passage through it.

As all the circumstances of the phenomenon were similar on the same day end during the same hours in 1832, and as extraordinary flights of shooting stars were seen et many places, both ln Europe and America, on the 13th of November, 1834, and also on the same day of every succeeding year, tending also from a fixed point in the constellation Leo—it has been conjectured with much apparent probebility that this gronp of hodies performs its revolution round the sun in a period of abont 182 days, in an elliptic orhit, whose major axis is 119 millions of miles; and that its aphelion distance, whan it comes in contact with the earth's atmosphere, is about 95 millions of miles, or nearly the same with the mean distance of the earth from the sun. This body must have met with disturbance after 1799, which prevented it from enconntering the earth for 32 years, and it may again deviate from its path from the same cause. How far these conjectures respecting the form and position of the orhit correspond with ohservation, time alone will show; but every circumstance tends more and more to confirm the existence of a zone composed of millions of little bodies, whose orhits meet the plane of the ecliptic towards the point which the earth occupies each year between the 11th and 13th of November. Thus, as M. Arago observes, a new planetary world is ebout to be revealed to us.—*Mrs. Somerville.*

ON SKINNING, PRESERVING, AND STUFFING BIRDS, FOR CABINETS.

Have ready for use some cotton wadding, some burnt alum in powder, a hlunt moderately-large wire, ebout fonr inches long, and e pair of scissors: and if the stuffing and mounting are to be proceeded with immediately some tow, some iron wire, with e file to point it, a long tapering brad-ewl, and various sprigs of wood will also be necessary.

In proceeding to skin the hird, it shonld be laid on its back with the feathers of the breast seperated to the right and left, when a broad interval will be discovered reaching from the top to the bottom of the hreast-hone. The scissors must be inserted at the point of the bone, and cut the outer skin from thence to the vent, taking care not to penetrata so deep as the flesh, or npon the inner skin which covers the intestines. The skin will then be easily separated from the flesh, in larger specimens by the fingers, in smaller by passing the blunt wire between the skin and the body observing et all times to push the skin rether than pull it, which is very likely to tear, or to stretch out of shape,—the legs may then be slipped up, and are to be cut through et the middle of the thigh-bone, and all the flesh npon tbe skin carefully cut awey, and the clean bone rubbed with the burnt alum. This must also be rubhed over every part of the skin as separated from the flesh, in order to prevent soiling it with blood, and to preserve it afterwards from tbe depredations of insects.

The skinning is now to be continued to the rump, which is cut off close, but so as not to injure the tail feathers. The lower part of the body being now loosened, the skin mey be drawn hack till the wings prevent its being drawn further. The wings are then to be drawn out and cut off at the shoulder, the upper bones being cleaned and rubbed as the legs had been before. The skin is still drewn back, (but not so as to stretch the neck,) nntil the base of the skull is laid hare, when the whole body is cut eway close to the skull, and also a part of the hack of the skull itself, in order to take out, through the opening of the brains, the eyes, and any fleshy part not wanted in the stuffing. When the skin is wiped dry in every part, end examined, in order to remove any particle of flesh or fat that may edhere to it, the operation of skinning is complete, and nothing

remains to be done, but to put a piece of camphor into the skull as a preservative against insects. Those who are particular in the beauty of their collection, place artificial eyes in the orbits while the skin is yet pliable, not waiting for the time of stuffing, which may be done at any future time.

Some birds require a somewhat different treatment, as the large-headed birds, like the duck and woodpecker; these will not admit the skin being drawn over the head. In such a case make an incision under the throat, through which remove the greater part of the head; also in seal-birds, the fat is often very troublesome—should it prove so, pounded chalk will be found an excellent absorbent. When the skins are merely wished preserved, the bones of the legs and wings should be wrapped round with cotton or tow, so as to supply the place of the flesh. The skin is then hung up by the heels to dry, in a current of air, the head being supported lest it stretch the neck too much.

In keeping bird-skins, each should be wrapped in a piece of paper and placed in a close dry drawer or box, along with camphor, turpentine, or myrrh, or any other strong aromatic.

Some persons have not sufficient faith in the preservative effects of burnt alum, but prefer anointing the skins either with the arsenical soap of Bécœur, or else washing them in a solution of corrosive sublimate, as recommended by Mr. Waterton, and now used so extensively in the preservation of all objects of natural history in this country.

[We give the receipts in our present number.]

It will be remarked that some parts of birds, particularly those naturally divested of feathers, as the necks of vultures, the combs of the Gallinaceous tribe, and the legs of most of the larger kinds, change color soon after death, and also that the color of the eyes cannot be preserved. It is therefore absolutely necessary that such notes should be made while the bird is yet alive, or soon afterwards, and sent home along with foreign bird-skins, as will enable a person here to imitate nature more accurately than he could otherwise do without these very requisite observations. It is, moreover, of considerable importance to mark the age of the bird and the season of the year when taken, because the plumage changes much by these circumstances.

(Continued on page 28.)

REVIEWS.

The Year Book of Facts in Science and Art—288 *Pages, with Engravings*—Simpkin & Co.

We hail with unfeigned pleasure this old friend with a new name, and have read it with the same zest as "The Arcana of Science" of former years. It is a continuation of that well-known work—compiled by the same Author, and with the same acute perception of what is useful and agreeable. It is, indeed, a boon to the rational inquirer to be furnished with so accurate, so extensive, and so cheap a manual of all the facts and improvements discovered in science, useful arts, and manufactures, throughout the world, for a whole year, at so small a sum as five shillings. It must have cost its talented Author immense research and expense in its compilation from such varied and numerous sources. We give the following extracts:—

Prepared Charcoal for Fuel.—"Charcoal, broken into small pieces, and steeped in a mixture composed of two gallons of water, one pound of quick lime, and ten ounces of salt, can be burnt at a slow rate, without the evolution of carbonic acid gas being sensible. It is known that lime will never absorb more than from sixty-two to sixty-four per cent. of the carbonic acid gas of which it is deprived by burning; also, one pound of charcoal will, during combustion, produce as much carbonic acid gas as can be absorbed by three pounds of lime."

[This is believed to be the preparation used in Joyce's patent stoves, of which so much has been said lately.—Ed.]

Pendulous Printing Press.—"Invented by Mr. Thomas Edmondson, for the purpose of dating the tickets given to passengers on the Newcastle and Carlisle railway. Upwards of 10,000 tickets can be printed by it with one supply of ink. This is accomplished by means of a riband, saturated with a peculiar inking composition, attached to two small rollers, and shifted by the pressure of the finger against the instrument. The impression, which is dry and permanent, is obtained by simply putting the ticket into a space left for it in the centre of the press."

Nail-Making in America.—"The first attempt to manufacture cut nails in New England was made in the southern part of Massachusetts, in the revolutionary war, with old iron hoops for the material, and a pair of shears for the machine. Since that period, besides supplying the consumption of the United States, estimated at from 10,000,000 to 100,000,000 pounds, and at a price not exceeding the duty, machines of American invention, for the manufacture of nails, have been introduced into England; and immense quantities of nails have been exported from the United States to foreign countries during the past year."

[The machines here alluded to manufacture all those varieties of cut brads, nails, &c., now in such general demand here.—Ed.]

Economy of Gas.—"A flame, consuming one-fifth of a cubic foot of gas per hour, will burn in a chamber and not be liable to be extinguished by the opening and shutting of doors; and, if due precaution be used, a flame may be preserved with a consumption only of one-eighth, or one-tenth, of a foot per hour."

Prepared Fuel for Steamers.—"A series of trials has been made at Woolwich Dock-yard with prepared fuel' for the use of Her Majesty's steamers. This fuel is a composition of 'screened' (otherwise almost uselessly small) coal, river mud, and tar, cast into brick-like moulds. In an engine worked with it, the consumption for six hours forty-five minutes was 750 pounds; the same engine, for the same period, requiring 1,165 pounds of north-country coals to keep it going; showing a saving of 415 pounds in favor of the new fuel. Next day, Welsh coal was used, and 1,046 pounds were consumed; and next, 1,098 pounds of Pontop coals were consumed during the six hours forty-five minutes; the engine easily performing the same work with 680 pounds of the prepared fuel; thus showing a reduction of 418 in favor of the invention. On the average of consecutive days, it required about fifty pounds less of the prepared fuel to get steam up, which was not only better maintained by very little feeding, but more readily obtained by the inflammable nature of the material. It has besides the advantage of being stowed away in a compact state, and not liable to act as a shifting ballast."

The Gaudin Light.—"On October 19, there were exhibited before the French Academy of Sciences some experiments in a new method of illumination proposed by M. Gaudin, which is stated to be an improved modification of the splendid Drummond light. While Drummond pours a stream of oxygen gas, through spirit of wine, upon unslaked lime, Gaudin employs a more ethereal kind of oxygen, which he conducts through burning essence of turpentine. The Drummond light is 1,500 times stronger than that of burning gas; the Gaudin Light is, we are assured by the inventor, as strong as that of the sun, or 30,000 times stronger than gas, and, of course, ten times more so than the Drummond.

M. Gaudin states his light to be of three degrees: the first is calculated to supplant the use of common gas, supplying a brighter and whiter light. The second, which is called 'star-light,' is brighter still, and proposed to be introduced into light-houses; a focus of the size of a nut giving out a blaze which it requires the protection of green spectacles to survey without injury. The third, which is called 'sun-light,' is stated to possess the dazzling brilliancy of that luminary. The Academicians are represented as being thrown into ecstasy by Gaudin's experimental results: but nothing in corroboration of the above startling statements, has yet appeared in England; save and except a claim of the priority of invention of such a light by Messrs. Keene and Gurney."

Wire Ropes in Mines.—"Count Breunner has recommended for deep mines and coal-pits the substitution of ropes made of twisted iron wire for the flat hempen ropes commonly in use. These iron ropes are of equal strength with a hempen rope of four times the weight: the diameter of the largest used in the deepest mines of Austria, is one inch and a half, the strength of which is little less than that of a solid iron bar of the same diameter. The usual weight lifted is 1,000 pounds; and, in one case, is a saving of about one-third of the power; for, four horses, with a wire rope, do the same work as six horses with a flat rope."

Manufacture of Iron with Gas.—"Mr. J. S. Dawes has communicated to the British Association a paper 'On the Improvement of the Manufacture of Iron, by the use, as a Fuel, of Gas obtained from Water.' Jets of steam are passed through red hot cast-iron pipes, filled with small coke or charcoal; decomposition immediately takes place; the base of the carbon of the coke combines with the oxygen base of the steam, forming, first, carbonic acid; but by passing this over a further portion of the red hot carbon, it is converted into carbonic oxide, sensible heat at the same time becoming latent on combining with the hydrogen base, producing hydrogen gas; which, together with the oxide before mentioned, is applied to the furnace by means of a jet inserted within the blast-pipe tuyere, the pressure upon the gas, of course, being equal to that upon the blast. An apparatus of this description has been in operation at Oldbury for several months, and the pipes are, apparently, little the worse for wear. The quantity of fuel required to keep them hot, is from twelve to fifteen hundred weight of small coal for twelve hours; and as the steam is obtained from the engine-boilers, the expense, with the exception of wear and tear, is comparatively trifling; so that the cost will not exceed three or four shillings per 1,000 feet."

Glegg's dry Gas Meter.—"This instrument consists of a pulse-glass, that is, two thin globes united by a tube. These globes are partially filled with alcohol and hermetically sealed when all the air is expelled from their interior. In this state, the application of a very slight degree of heat to one of the globes will cause the alcohol to rise into the other. The pulse-glass is fixed upon an axis, having a balance-weight projecting from it, and the axis works in bearings on the sides of a chamber, through which the gas to be measured is made to pass in two currents, one of which is heated and the other cold. The hot gas is made to enter opposite to, and to blow upon, the lower globe of the pulse-glass, while the cold gas blows upon the other. The difference of temperature by this means established between the globes causes the alcohol to rise into the upper one, and the glass turns over on its axis, thus varying its position, and bringing the full globe opposite to the hot stream of gas. This stream, with the assistance of the cold gas, which condenses the vapour in the top globe, repeats the operation; and the speed at which the globes oscillate will be precisely in proportion to the quantity of gas which has been blown upon them, provided an uniform difference of temperature is always maintained between the two streams of gas. The difference of temperature is established and rendered uniform by a small flame of gas, which heats a chamber through which the lower current of gas has to pass; and the arrangement for securing an equality of temperature is very ingenious. The instrument is first tested by making a given quantity of gas pass through it, and observing the number of oscillations of the pulse-glass, which, being established, it registers accurately."

Chemistry of Nature, by Hugo Reid.—Simpkin and Co.

A USEFUL, well-designed, and equally well-written book, the nature of which will be perfectly understood from its title. The Author tells us, "that it is not intended to convey instructions for performing experiments, but for those who may desire some general knowledge of the nature of chemical phenomena, and who may feel an interest in studying those natural phenomena, which consist in chemical action." We give an extract to show the style in which the work is written, and wish that our space allowed other and longer quotations, as every page would yield us something new—either in fact, form, or perspicuity:—

Color of the Air.—"When we look at the sky on a clear day, it seems like a light blue arch set above our heads and seen through the (supposed) invisible substance called air. But this is not the case: there there is no blue dome above us; and when the sky is viewed from any elevated region of the earth, as the top of a mountain, or in a balloon, and where we would expect that this supposed blue vault would be more distinct, and manifest its blue tint more decidedly, it appears not more blue, but dark or black, in proportion as the spectator rises above the surface of the earth *and has less air above him*, and *that very rare*, the blue tint gradually disappears, and if he could attain a height at which there is *no air*, the sky would be total darkness all around, except in the direction in which the sun's rays fall upon him. This is the appearance which, from the laws of optics, it is known would be presented when there is no air; and the observations of travellers who have ascended to great elevations on the Alps or the Andes confirm this. Again, when we look at a

any distant mountain on a tolerably clear day, it will appear of a blue color, somewhat like the sky, but a little deeper in the tint, and yet when we approach the mountain, we see that it is of a very different color; but if we recede to a great distance from it, it will acquire a bluish tint, which gradually deepens as our distance from it increases.

"In these cases, then, it is seen that where there is very little air, the sky has only a very slight tinge of blue, and that the strength of this blue tint diminishes as the quantity of air diminishes, and also that when we look at any very distant object, looking at it of course through a thick body of air, that object appears of a blue color, if not itself of this color it must acquire the hue from being seen through a blue-colored medium. These well established facts lead naturally to the inference that the *air itself is of a blue color.*"—*Page* 61.

MISCELLANIES.

For the Preservation of Objects of Natural History.

SOLUTION OF CORROSIVE SUBLIMATE.

PUT a large-sized tea-spoonful of well pounded corrosive sublimate into a wine-bottle full of alcohol (spirits of wine). Let it stand over night, and the next morning draw it off into a clean bottle. When the solution is applied to black substances, and little white particles are perceived on them, it will be necessary to make it weaker, by the addition of some alcohol.

A black feather, dipped in the solution, and then dried, will be a very good test of the state of the solution: if it be too strong, it will leave a whiteness on the feather.

ARSENICAL SOAP.

Invented by Becœur, Apothecary, Metz.

Arsenic, in Powder	2 ounces.
Camphor	5 drams.
White Soap	2 ounces.
Salt of Tartar	¾ „
Powdered Lime	¼ „

The soap must be cut in small and very thin slices, put into a crucible with a small quantity of water, held over a gentle fire, and frequently stirred with a wooden spatula, or a piece of wood of any kind. When it is properly melted, the powdered lime and salt of tartar must then be added, and thoroughly mixed. It must now be taken off the fire, the arsenic added gently and stirred. The camphor must be reduced into a powder, by beating it in a mortar, with the addition of a little spirits of wine. The camphor must then be added, and the composition well mixed with a spatula, while off the fire. It may be again placed on the fire, to assist in making the ingredients incorporate properly, but not much heated, as the camphor will very rapidly escape. It may now be poured into glazed earthen pots, and allowed to cool, after which a piece of paper should be placed over the top, and afterwards some sheep leather; and then set aside for use. The composition is about the thickness of ordinary flour paste.

When it is necessary to use the soap, put as much as will answer the purpose into a preserve pot, and add to it about an equal proportion of water. This is applied to the skin or feathers with a bristle brush.

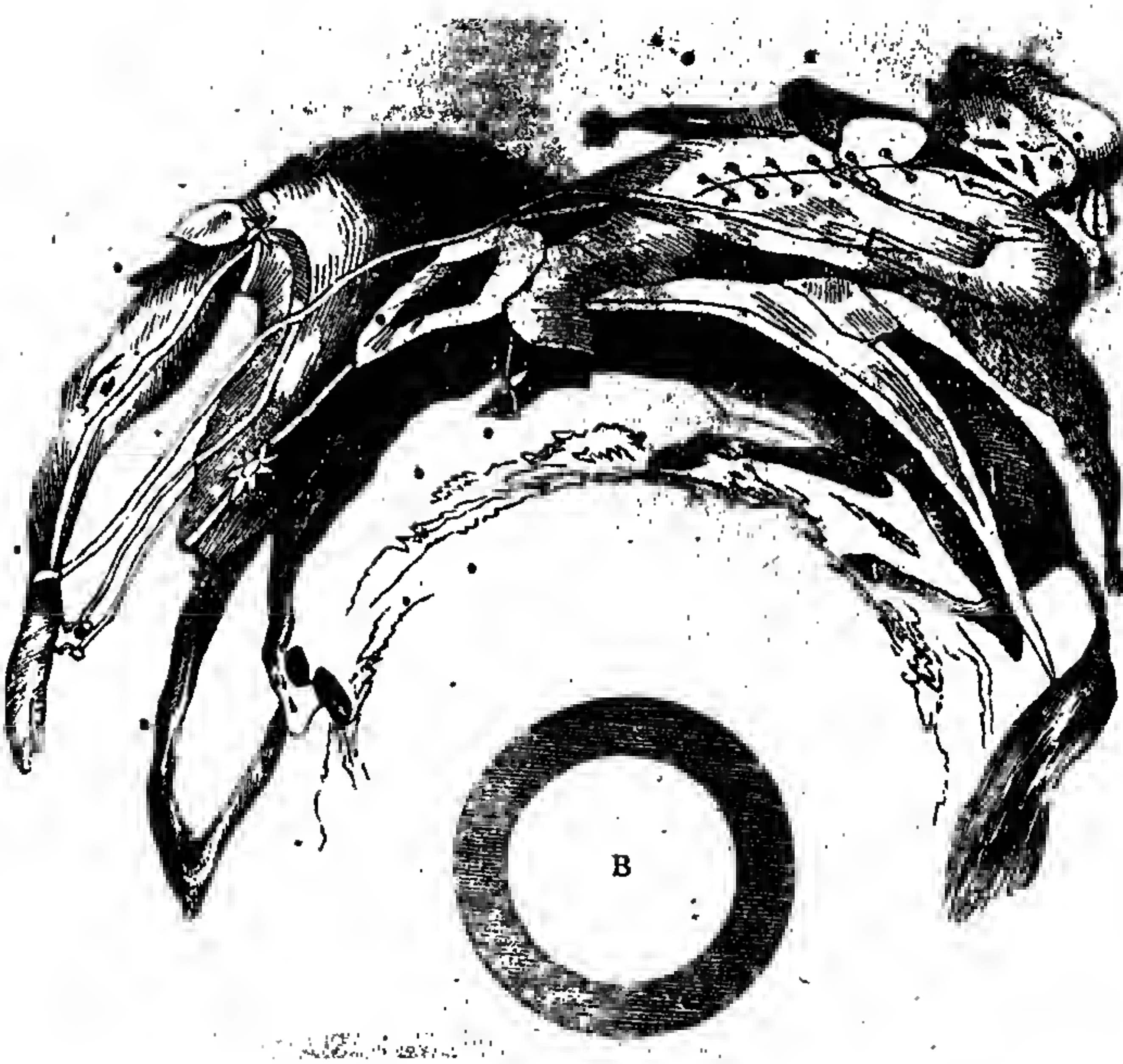
N.B. It should be kept as close as possible, and used with caution, as it is a deadly poison.

The above is the recipe made use of at the Jardin des Plantes, Paris.

Phosphorus.—M. Becquerel is of opinion that electric light renders certain bodies phosphorescent when they have for some time been exposed to its action. The violet rays possess the greatest degree of this power, while the red rays are entirely destitute of it. Those substances which suffer almost all white rays to pass through them, reduce their phosphorescent property to nearly one-half.

Vegetable Productions of England.—No country in the world can at the present day compete with England in the beauty of its flowers, the utility of its fruits, and the variety of its agricultural produce; yet in former days our country yielded scarcely any vegetable valuable as food, or charming as ornament. The Romans brought us grain and grapes—the Saxons many of our trees—the monks of after times imported from foreign convent-gardens numerous flowers, pulse, medicinal plants, and (into Ireland) the Arbutus tree. (*This is found wild only near Killarney, where Mucruss Abbey once stood.*) Even the Elder tree, now so widely distributed throughout the country, is said to have come originally from Persia, the native country of the Roses and the Lilac. So bare were once these islands in vegetable produce, that the berries of the hedges—the acorn of the Oak—the husky mast of the Beech, and a few esculent plants scattered over the fields, but no where very abundant, constituted the only vegetable food of the Ancient Britons; for luxuries, they had indeed the delicious Wood Strawberry—the Raspberry—the Blackberry—the Bilberry—the little sweet and black wild Cherry—and in the north of the kingdom, sparingly, the Cloudberry and the Cranberry. It is true Pears, Apples, and Prunes are indigenous, but how different the austere Sloe and the wild Plum from the luscious fruit of our times. The Pears were then, and indeed are now, in a wild state, small and hard—the Apples sour and crabbed. All other things have been from time to time imported; Wheat and Rye came originally from Tartary—Asparagus was first brought from Asia—the Pine-apple, the Peach, and Tobacco from America—Cauliflowers from Cyprus—the Chervil from Italy—Cabbage, Lettuce, and Endive from Holland—Fennel from the Canary Isles—Gourds, Pumpkins, and Cucumbers from the East—Kidney-Beans and Sugar from India—Lentils from France—the Potatoe from Brazil—the Broad-Bean from Egypt—Rice from Ethiopia—Shalot from Siberia—the Tulip from Cappadocia—the Daffodil from Italy—the Lily from Syria—the Tuberose from Java—the Camellia and Tea from China—the Apricot and Almond from Palestine—the Carnation—the Pink, and the Jasmine from Italy—the Michaelmas Daisy from the United States—and the splendid, ever-varying Dahlia from Mexico.

Proportion of Gluten in Grain.—M. Boussingault has made some researches on the proportions of gluten contained in the flour of different kinds of grain cultivated in the same soil. He determined the quantity of gluten by ascertaining that of ammonia which each yielded; this plan being attended by more precise results than that of working the flour between the fingers under a stream of water. The flour from corn grown in the Jardin des Plantes yielded gluten in the proportions of one to fifteen; the differences dependant upon the influences of the soil and that of the climate are much more strongly marked, and amount to from one to four.



THE MAGIC MIRROR.

OPTICS AND OPTICAL INSTRUMENTS.

The science of optics is one which seems, by universal consent, to be devoted to our amusement, and optical instruments present to us such wonderful and unexpected appearances, that they are generally sought for, and examined with the greatest interest. This is not merely the case with any one particular class or age of persons. All are and ever must be interested in this science, for it explains all the phenomena of LIGHT, its diffusion around us, its reflection, its concentration, its colors, and the laws which govern the harmony of those colors. The admirable structure of the eye is explained, and the noble sense of seeing is assisted, strengthened, and regulated, by the valuable information a knowledge of optics communicates. But these are only a very few of the benefits derivable from this source, as may be imagined from the variety and surpassing utility of optical instruments. For example: the great telescope of Herschel, which directs the eye of man to calculate motions and changes, and forms, millions and millions of miles beyond our world—showing that

> All are but parts of one stupendous whole
> Whose body Nature is, and God the soul.

and the microscope, which proves that the minutest objects of creation are equally perfect with the greatest, and equally adapted to the contingent circumstances of their existence; and, however it may surpass our imagination, proves that the very rocks, extensive beds of earth, even the mighty pyramids themselves, are but an aggregation of what once were animated, perfect, and happy creatures—all with their respective organs, and yet so minute that a solid inch would contain more in number than the whole inhabitants of the globe. Besides these mighty engines of human knowledge are other instruments of the most unappreciable value, and also others that have been invented solely to conduce to our amusement—such are the very numerous optical illusions and public optical exhibitions. Let not the cynic look with contempt upon the magic lanthorn, the thaumatrope, or the mirrors, for they all are dependent upon certain and unerring principles, and the explanation of those principles has occupied the life of a Newton and a Brewster.

The familiar explanation of some of these curious instruments will, from time to time, occupy our attention. We have already shown the construction of the Camera Obscura, and now proceed to describe another very simple, but very curious, apparatus.

THE MAGIC MIRROR.

THE monstrous projection of a German horseman, (represented in our cut,) is one of those peculiarly constructed objects, which however distorted they may appear when painted upon a flat surface, or reflected from a plane mirror, yet become perfectly proportionate when seen from one which is cylindrical. The drawing of such figures involves many difficulties, and a most accurate knowledge of perspective. The following remarks may, however, render the subject in some degree intelligible. It is known to all, that, if a person stand exactly in front of a looking glass, the rays of light from himself fall direct upon the glass, and are reflected back to himself again; so, also, if a person stand towards one side of such a glass, and look upon it obliquely, the rays will not fall back upon himself, but in a different direction, in proportion to his position—or, in other words, that he will not see himself, but another person, if there should be one towards that side. This is because the angle of incidence is equal to the angle of reflection; or, at exactly the same angle the ray of light strikes the flat body, it is thrown off again towards the contrary side; just as a marble striking a wall obliquely, flies not back to the hand that projected it, but away from the wall again, at a certain angle with it, but still away from the hand. Also, it is apparent that objects as seen upon flat mirrors are not distorted, because all the rays strike the mirror, and are reflected back again at equal angles. Such is not the case with mirrors of any other shape, such as convex, concave, cylindrical, conical, &c., which widen, elongate, or misrepresent the well-proportioned objects presented to them. Of course the contrary to this holds good when the circumstances are changed: thus, in order that any figure may be seen in accurate proportion, on a cylindrical mirror, it must be drawn proportionably distorted. A recollection of the law of incidence will enable any one to represent monstrous pictures, (such as our present engraving,) for it will be perceived, that the central line is drawn in its proper proportions, but the further from that the picture is carried, the more monstrous is it drawn—thus the head of the man is but little widened, that of the horse is perfectly absurd—the hind legs of the animal tolerably accurate—its fore legs ridiculous: and the reason will be evident, for a ray of light striking the surface of the cylinder direct, is reflected also direct, but as the cylinder departs more and more from the flat surface necessary for just proportion, so the rays are reflected more and more obliquely, until at last, near the sides of the cylinder, they are almost lost in the extent of their obliquity.

The subject may be explained mathematically, thus: draw a semi-circle, equal in diameter to the cylindrical mirror, and divide into a certain number of equal parts. To this semi-circle draw a tangent parallel to the diameter, and from the centre of the circle, through each of the divisions made, draw lines meeting the tangent—these lines will vary in length in the same proportion as the object is to be distorted. To delineate any picture fixed upon, divide it into the same number of vertical lines as the semi-circle was divided into, then draw a circle of a size you would have a picture of, and set off upon it a number of lines equal or proportionate to those of the various *secants*, or the lines that cut the semi-circle, and draw between them the various parts of the picture fixed upon for delineation.

A in the figure represents the distorted image to be viewed, and B the size of the cylindrical mirror.

[To form which see No. IV. page 31.]

ELECTRICITY.

(Resumed from page 1.)

Ex. 10.—Rub or grate together two round uncut stones, of quartz, calcedony, cornelian, &c., and a strong phosphoric light and odour will be produced, showing another peculiarity: viz., that the electric fluid is perceptible to our sense of smelling.

Ex. 11.—Break a large lump of loaf sugar in the dark, or pound it in a mortar, when it will appear covered with a beautiful lambent blue flame. When grocers are sawing up loaves of sugar as samples, the dust is most luminous and beautiful.

Ex. 12.—In grinding coffee, particularly if it be fresh burnt, it will be seen to cling around the lower part of the mill, and also around the cup or basin held to catch it—sometimes so strongly as to cover the sides two inches or more above the general surface.

Ex. 13.—Put upon the same leg a worsted stocking, and over this a silk one. Warm the leg at the fire, and rub the hand over the stockings. This done, slip off the silk stocking suddenly, and the two sides of it will recede from each other, and the whole retain the same shape as if the leg still remained in it.

Ex. 14.—Take a glass tube, about two feet long, and an inch in diameter—warm it and rub it with a warm flannel. It will show strong signs of attraction to any light body brought near it.

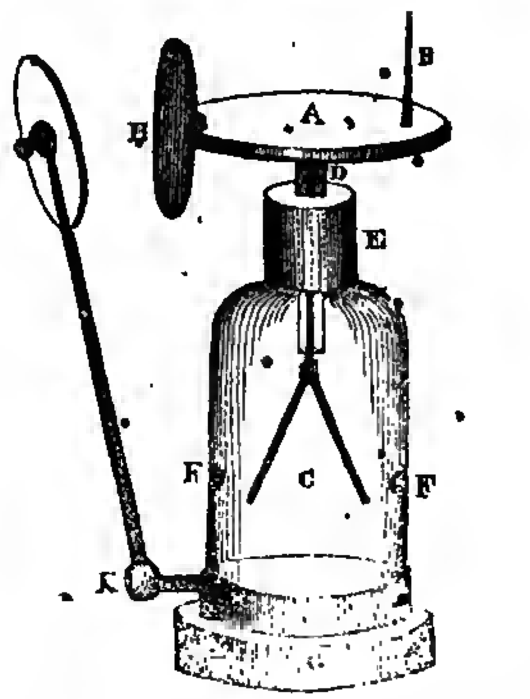
Ex. 15.—If, while still excited, a light fleecy feather be brought near, it will at first cling to the glass rod, and afterwards fly away from it, and may be driven about a room, by holding the glass between it and any surrounding object. If it should touch any thing not electrified, it will fly back to the glass again.

Ex. 16.—Suspend from the ceiling a metallic ball, by a silk cord, and touch it with the excited glass rod. This ball will now attract light bodies in nearly the same manner as the glass rod itself

does. This is called *communicated* electricity, while the glass rod acts by *excited* electricity.

These experiments are but a very few which might be devised to show the universality of the electric fluid. They are but transient, because we have employed no instrument to prevent the escape of the fluid put into action, (except, indeed, in the last experiment.) One of the simplest and most useful of them is Bennet's Gold-leaf Electrometer, which will not only have the desired object, at least for a considerable time, but enable us to show that the most trivial actions we do, in a proportionate degree, display electrical appearances.

THE GOLD-LEAF ELECTROMETER.



A is a brass plate, (called the cap,) about four inches in diameter, having a wire fastened to the middle of it. This wire passes down the glass tube D, into the glass vessel FF. When the wire has reached about one inch into this vessel, it is slit at the end, and a little bit of card fastened into the slit. A strip of gold leaf, half an inch wide and three inches long, is now pasted upon each side of the card, so as to touch the wire above, and hang free from the glass around. E is a wooden top for the convenience of fastening the parts together, and G is the foot-board or stand of the instrument. At FF, on two opposite sides of the glass, are pasted two slips of tin foil, to carry off the superabundant fluid to the foot of the instrument.

The pointed wire B forms no part of the instrument itself, nor yet do the plates H & I. These two latter are called "The Electrical Doubler," and are used to indicate the presence of a still more minute quantity of electricity than the instrument without them is capable of making manifest. Their mode of action will hereafter be explained under electrical induction, as the pointed wire will when the subject leads us to consider the influence of points.

Obs.—A cheap and good substitute for the above may be made of a common six-ounce phial. A wire passing through the cork of it, having the gold leaves within the phial, and a brass *ball* or a bullet above. A lamp glass, also, with a cork above and below, (ball and gold leaves similarly arranged,) answers every purpose, the bit of card, also, is of little consequence; and let it be remarked, once for all, that whenever *glass* apparatus is employed, it must be kept perfectly dry, slightly warm, and free from dust. Of so much consequence is this, that should there have been a failure in any of the simple experiments, it most probably has arisen from neglect of this precaution.

There are numerous variations of this instrument, according to the purposes for which they are required. One of extreme delicacy, though not so much so as that with gold leaves, is made with two very fine strips of straw, suspended on little wire loops. Another is furnished with two extremely delicate silver wires, with small pith balls attached: this is used chiefly for experiments upon the electrical state of the atmosphere. This with numerous other electrometers will be described hereafter.

Ex. 17.—Hold near the above instrument any of the excited bodies used before—such as the paper, or the glass rod, and the gold leaves will diverge to a considerable distance from each other, and remain so for some time. A well-excited glass tube will stimulate it at a distance of two or three feet, and must not be brought too rapidly close to it, or the gold leaves will be rent to atoms by the violence of the action.

Ex. 18.—Brush the cap of the electrometer with the feathery part of a quill, and the gold leaves will instantly diverge.

Ex. 19.—Give the cap a blow or two with the corner of a black silk handkerchief, previously warmed, and the friction, small as it is, will be found to have the same effect as before.

Ex. 20.—Place upon the cap a small tin dish or patty pan, having in it a red hot coal just taken out of the fire. Sprinkle upon the coal a few drops of water—the evaporation of this will set the gold leaves into considerable action. This will not succeed with either charcoal or coke. It does best with a hot iron put into the water.

Ex. 21.—Sift some steel, brass, or other metallic filings, upon the cap of the electrometer, from out of a metallic sieve. These filings become electrical by the friction merely of passing through the holes of the sieve, and will consequently affect the gold leaves.

Ex. 22.—Take a knife, with a glass or ivory handle, and cut some small pieces off a slip of deal, so that they shall fall upon the cap as before. Each piece carrying down with it a portion of the fluid disturbed, will, in a similar manner, affect the instrument.

Thus it will be seen, that a person brushing a coat, cleaning windows, beating a carpet, placing a kettle on the fire to boil, sifting cinders, or planing a board, a school-boy rubbing out the lines of his cyphering book, or his master making a pen, is, during the time he is so employed, as effectually an electrical machine as the most elaborate apparatus made by all the art of the optician. Many manufacturers, indeed, find the fluid somewhat inconvenient. In the weaving of different textures, such as bombazine, where worsted and silk are intermixed, the work is very electrical. In the making of chocolate great care must be taken, that, in cooling in the pans, no dust shall come near it, or it would attract it so much as to become unsaleable; as is the case also with sealing wax in large quantities. The grinding of coffee has been already mentioned, and in grinding wheat or malt it is no less conspicuous, though few suppose that electricity assists in making the miller *white*. The workers in amber are so annoyed by its strong, attractive, and easily-excitable tendency, as to have the nerves of

their hands and wrists disagreeably acted upon. In the glass manufacture, very numerous instances of electrical attraction occur. In fact, in certain parts of the process, the utmost care is requisite to prevent the glass from attracting the particles of dust around it. The process of gilding picture frames, also, is much assisted by this wonderful agent. Before the gold is stuck on, the frame is washed over with spirit, this evaporates, the evaporation makes it electrical, and the gold leaf when held to it attaches itself immediately to all the mouldings and ornaments.

(*Continued on Page 42.*)

MEASURING HEIGHTS BY BOILING WATER.

The fact that water boils at the heat of 212° F. is to be considered but as the average temperature of it, when in that state of ebullition called boiling. It is well known that in vacuo it boils at very many degrees less, and from this fact it becomes evident that the density or rarity of the air much influences the boiling point. When the atmosphere is dense and heavy it meets with more resistance in passing into steam, and, therefore, becomes hotter. In contrary circumstances it will scarcely rise above 210° instead of 212°. Simple and apparent as this fact is, it is somewhat surprising that the temperature of boiling water should never have been applied to measure the height of mountains, &c. A paper, however, upon this subject, appears in the Philosophical Magazine for March, from which the principle appears to have been applied with complete success by the late Don Francisco Jose Caldas, and carried out into actual practice, by Colonel R. Wright, in ascertaining the height of some of the Pampas. This gentleman found, after repeated experiments, that water boiled at one degree less at every 604 feet of elevation, from which he was able clearly, and with little trouble, to check the measurements of Humboldt and others, with every appearance of accuracy; and should after observations confirm this method as available, and universally applicable, it will be a great point in science gained, because of the little dependence there is to be placed upon the usual method of taking heights by the barometer, on account of the liability of that instrument to accident and inaccuracy, and, to be affected by that atmospheric irregularity so common in mountainous regions.

MAGNETIC RELATIONS OF METALS.

It has been long maintained, that, as there appeared to be a concentration of magnetic effect in the arctic and antarctic regions, where the two magnetic poles are situated, that, therefore, it was probable cold might be the disturbing if not the primary cause of magnetic attraction; and following the same train of reasoning a little further, that all the other metals, besides iron and nickel, would become magnetic if cooled down to a certain temperature. Professor Faraday has lately most completely, and at once, set the matter at rest, with his accustomed talent and acumen, working as he did with M. Thilorier's beautiful apparatus, for giving both the liquid and solid state to carbonic acid gas.

The various metals were cooled by the most ingenious method, and with every care to accuracy, until they were at a temperature of 112° below 0° of Fahrenheit—and being tested by a most delicate astatic needle, not one of the metals, not even manganese, was found to have acquired the least sensible portion of magnetism, except in one or two instances, in which the metals were found adulterated with iron. Upon this subject Professor Faraday writes as follows:—

"The substances were cooled by immersion in the mixture of ether and solid carbonic acid, and moved either by platina wires attached to them, or by small wooden tongs, also cooled. The temperature, according to Thilorier, would be about 112° below 0° of Fahrenheit. The test of magnetic power was a double astatic needle, each of the two constituent needles being small and powerful, so that the whole system was very sensible to any substance capable of having magnetism induced in it when brought near one of the four poles. Great care was required and was taken to avoid the effect of the downward current of air formed by the cooled body; very thin plates of mica being interposed in the most important cases.

"The following metals gave no indications of any magnetic power when thus cooled to—112° Fahr.

Antimony,	Lead,
Arsenic,	Mercury,
Bismuth,	Palladium,
Cadmium,	Platinum,
Chromium,	Rhodium,
Cobalt,	Silver,
Copper,	Tin,
Gold,	Zinc.

"A piece of metallic *manganese*, given to me by Mr. Everett, was very slightly magnetic and polar at *common* temperatures. It was not more magnetic when cooled to the lowest degree. Hence I believe the statement with regard to its acquiring such powers under such circumstances to be inaccurate. Upon very careful examination a trace of iron was found in the piece of metal, and to that I think the magnetic property which it possessed must be attributed.

"I was very careful in ascertaining that pure *cobalt* did not become magnetic at the very low temperature produced.

"The native alloy of iridium and osmium, and also crystals of titanium, were found to be slightly magnetic at common temperatures; I believe because of the presence of iron in them. Being cooled to the lowest degree they did not present any additional magnetic force, and therefore it may be concluded that *iridium*, *osmium*, and *titanium* may be added as non-magnetic metals to the list already given.

"Carbon and the following metallic combinations were then experimented upon in a similar manner, but all the results were negative: not one of the bodies gave the least sign of the acquirement of magnetic power by the cold applied.

1. Carbon.
2. Hæmatite.
3. Protoxide of lead.
4. ——— antimony.
5. ——— bismuth.
6. White arsenic.
7. Native oxide of tin.
8. ——— manganese.
9. Chloride of silver.
10. ——— lead.
11. Iodide of mercury.
12. Galena.
13. Realgar.
14. Orpiment.
15. Dense native cinnabar.

16. Sulphuret of silver.
17. ——— copper.
18. Sulphuret of tin.
19. ——— bismuth.
20. ——— antimony.
21. Protosul. iron crystallized.
22. ——— anhydrous.

"The carbon was the dense hard kind obtained from gas retorts; the substances 3. 4. 5. 6. 9. 10. 11. and some of the sulphurets had been first fused and solidified; and all the bodies were taken in the most solid and dense state which they could acquire.

"It is perhaps superfluous to add, except in reference to effects which have been supposed by some to occur in northern latitudes, that the iron and nickel did not appear to suffer any abatement of their peculiar power when cooled to the very lowest degree."

ALCOHOL.

It is generally supposed that alcohol, obtained from different vinous productions, does not chemically differ. M. Jouhault, a German chemist, informs us, that he has discovered a very great difference in the alcohol he obtained from grapes, sugar, malt, honey, and saccharine vegetables. The alcohol obtained from fermented honey, he states, is lighter, and less stimulating to the palate and stomach, than that procured from brandy, rum, or any other article. The alcohol obtained from malt is the heaviest and most stimulating, and when administered, in the quantity of a table spoonful three times a day, to a large robust dog, will destroy life in the course of a week—yet all the gin manufactured in England, and the compounds, cordials, and tinctures, are made with this caustic spirit. The spirit obtained by fermenting the most saccharine potatoe, he contends, is the mildest, and this spirit is now made in considerable quantities in Paris—and an establishment existed at Vauxhall, a few years since, for making spirit from potatoes; but as a commercial speculation it failed, owing to various causes not now necessary to enter into. The alcohol obtained by distilling fermented sugar, treacle, or rum, he says, is a powerful caustic, capable of dissolving bone, and corroding living parts. About six years ago, we made several experiments with vegetable articles, containing saccharine matter, with a view of ascertaining the cheapest method of obtaining alcohol, and, on comparing the articles we procured from each, certainly found them to differ both in flavor and specific gravity. The alcohol from fermented honey is not only specifically lighter than any other we procured, but much softer, and more pleasant to the taste. This spirit, we are informed, some perfumers in Paris employ to make their odoriferous articles, as lavender water, &c. From pea-shells we obtained a very sweet spirit, at the cost of two shillings per gallon.

From Beet-root, the same quality, at		2s. 6d.	a gallon
,, Mangle Wurzle,	,,	2s. 3d.	,,
,, The Parsnip,	,,	2s. 6d.	,,
,, The Carrot,	,,	2s. 9d.	,,
,, The Turnip,	,,	3s. 0d.	,,
,, Malt and Barley mixed		2s. 3d.	,,

The alcohol of the turnip is very offensive, nor could we by any process render it sweet. The other spirits were very sweet, and in the country, where the articles may be obtained at a much cheaper rate than here, the spirit may be made at nearly half the price. From the potatoe we obtained so small a quantity of spirit, that it was much dearer than that we procured from treacle or malt. The moist sugar of the West Indies produced more spirit than that of the East Indies, a proof that the former is the stronger. Alcohol, however, it may be remarked, when highly rectified, that is purified to the highest degree, differs very little in flavor, whatever may be the materials from which it is originally made. In this highly-rectified state, therefore, it is not understood to be, but in that more usual condition in which it is used, previous to blending with it those flavoring ingredients that claim for it the name of gin, cordials, &c. In this state of impurity the spirit is mixed with an empyrheumatic oil, differing in flavor according to the mode of preparation, and still more so according to the ingredients from which the spirit is originally made. Thus the flavor of French brandy is derived from the grape from which is made.

Rum from a peculiar	oil	in	Sugar.
Malt	,,	,,	Barley.
Scotch Whiskey		,,	Oats.
Arrack	,,	,,	Rice.
Koumis	,,	,,	Mare's Milk.

DRAWING AND PAINTING.

All Arts and Sciences have terms and processes peculiar to themselves. In many cases the student learns these, not as fundamental and necessary guides to a right understanding of his subject, but rather *picks them up* by degrees in his progress, and very many of them he is often ignorant of, even after a long practice of the art to which they allude. This arises, chiefly, from the generality of books of science and art not containing any glossary to these difficulties. It is much to be regretted that the remark should apply with so much force to the Fine Arts, as it not only retards the practical progress of the student, but prevents him discovering the beauties, and marking the characteristics, of some of the sublimest conceptions of genius. We therefore purpose to give such a glossary, believing that as all persons of education and refinement love pictures and statuary, it may be useful to them as well as to the draughtsman.

TERMS AND MATERIALS.

Point. Dot.—An imaginary place to which lines may be drawn.

Line.—A mark made from one point to another. It may be straight, curved, mixed, or crooked, and drawn either parallel to another; vertical, upright or perpendicular, diagonal, or slanting, and horizontal or across, from side to side.

Outline is the line or lines bounding an object, whether it be formed by a pencil, pen, or in any other manner—as, for example, where two colors meet each other abruptly.

Surface or *Superfices.*—Any body having length and breadth. In drawing, the word surface implies, chiefly, that part of the ground, sea, or sky, upon which the principal objects are represented.

The Remote Distance or *Back-Ground* is that part farthest removed from the eye. The pictures of Claude are so celebrated for their extreme extent of view, or for their remote distance, that it has been facetiously observed, "A Claude's landscape is a day's journey." The objects on this part of the picture are necessarily small and obscure, and in colored landscapes partake more or less of the color of the

atmosphere—thus, in a clear day, a light blue preponderates in parts most remote—in a fog, the distance is white and much obscured—in moonlight scenes, totally black—in sea-scapes, gradually losing color, and partaking more or less of that of the sky, for in water views the reflection of light is of the utmost consequence to be attended to.

The Mid-Distance.—Parts of a picture between the fore-ground and the remote parts. It is here that the chief excellences of a picture should be aggregated. A careful obscurity is often all that is sufficient for the distance, and a few bold touches may serve as a fore-ground; but, in the middle parts, harmony of coloring, accuracy of drawing, and tasteful grouping, are essentially necessary. Of course the remark is more or less applicable according as the mid-distance blends with the remote parts, or with the fore-ground.

The Fore-Ground is that part of a picture nearest the eye. It is here that the warmer tints and boldest touches are generally found—it being necessary that each object placed so near to the observer should be drawn with the utmost exactitude—each rock, each tree, with all its characters—each flower even in its proper colors and natural habit.

These three terms of remote, mid-distance, and ground, are equally applicable to sea views, and sky and clouds, which suffer the same gradation in tint and clearness as the ground. Thus a cloud seen afar off, equally with any other object, is dim and obscure, while one that is near is to be proportionably well defined; so also as to ships on the water, or birds flying—for, however strange it may appear, it is perfectly correct to say, "the ships on the fore-ground,"—"the bird in the mid-distance,"—or, "the clouds in the remote distance."

In some pictures the parts described are gradually blended with each other, and a correspondent gradation of tint observed—such are some of the fine landscapes of Claude, Wouvermans, and Wilson. Others have them clearly distinct, and when this is the case the fore-ground is often made to contrast finely with the rest of the view; thus, for example, a sunlight view seen through umbrageous foliage, or a palace viewed from a gloomy archway. Our annuals and pictorial periodicals show many such instances. In the representation of small scenes, or individual objects, no extreme distance, and often no mid-distance, is perceptible; thus it is with architectural elevations, groups of flowers, interiors, &c. In these cases no obscurity is admissible, and so particular have been some painters in this respect, that the accuracy and truth of delineation of their pictures constitute their chief merit. In one of Gerard Dow's celebrated pictures, "The Seedsman's Shop," every thing is so accurate, that by the aid of a strong magnifying glass, the seeds in the window may be referred to the plants they were produced from, or be known by name. This is an extraordinary case, and perhaps the principle is carried much too far, as such attention to minutiæ would soon destroy freedom of touch, and boldness of execution.

In the pictures of Claude, the distances demand the closest attention of the student. It may be observed, that he manages his aerial tints with the greatest possible truth and skill, while a sweet simplicity pervades his compositions. His knowledge of architecture enabled him to give an imposing air of grandeur to some of his subjects; but his chief excellence consists in his management of the gradations of aerial effect.

Delightful specimens of neatness and truth of touch may be seen in the landscapes of Berchem, who is also remarkable for breadth and just distribution of light, as well as for transparency and brilliancy of coloring. His figures, also, are well drawn; but he is most eminently successful where trees are intermingled with ruins, and he communicates to such scenes a richness and beauty truly surprising.

Admirable imitations of natural effects are exemplified in the landscapes of Teniers. It is a frequent practice of this great master to place his principal light on the fore-ground, while he scatters his subordinate light, in a most beautiful manner, over the scene, keeping the whole in strict accordance with a luminous sky.

It might be out of place here to dilate on the talents possessed by different artists in expressing the truth of nature with facility; but it may be remarked in passing, that if the student should meet with a landscape by Pynacker, he ought not to omit observing and studying the truth in the drawing and coloring of the herbage and plants which enrich the fore-ground; and if he meet with a piece by Ruysdael, he ought to observe and study the sparkling touch and color which he imparts to water, whether it rolls away as a streamlet, or tumbles in a cascade over a precipice.

Embellishments.—Such parts of a picture are called embellishments as are added to heighten or show off to better advantage the general design.

The term is particularly applied to groups of figures in a landscape. Many conflicting opinions have prevailed, with respect to the propriety of introducing groups of human figures in landscapes, but the difference of the artists on this point has not led to any decision of the question. It may be alleged, with some show of reason, that too many figures have a tendency to disturb the requisite repose of a beautiful scene; but, on the other hand, the want of figures most certainly tends to excite an idea of desertion, if not of desolation.

A medium between these two extremes may, perhaps, be the most judicious and conformable to good taste. Figures, for example, are natural and proper on a road; they are useful as a scale of measurement, to which to refer surrounding objects, as tall trees or lofty buildings; they conduce to the interest of particular scenery, and serve to characterize it, and they may be made to communicate historical interest to a picture otherwise rich, as is well exemplified in some of the admirable and too much neglected pieces of Wilson. Groups of figures may often be seen in the pictures of Teniers, Wouvermans, Claude, and Cuyp, who seldom omitted to embellish their landscapes in this way with conspicuous assemblages of figures.

Supported by such authorities, we may well consider figures as an excellent adjunct for imparting richness and color to fore-grounds, and as useful for detaching masses or distances; bearing always in mind, that whatever figures are introduced must accord in character with the other parts of the piece.

(Continued on page 54.)

REVIEW.

Parlour Magic. Whitehead, Fleet Street. 194 *Pages, and numerous Wood Cuts.*

THIS is one among the numerous collections of experiments, which of late years have tended much

to give the young an insight into, and a taste for science. The Author has evidently taken much care with his subject, and collected together numerous of the wonders of light and sound, of chymistry and optics, the elements, &c., not forgetting the absorbing subject, (to boys,) of leger-de-main and conjuring. We will not say that a better collection might not have been made: it is enough to remark that it is a very good one, though we may be allowed to hint that it is scarcely safe to trust children with sulphuret of carbon, chlorines, &c., nor yet to suffer them to inspire hydrogen. Many of the experiments are new, and others which we are glad to see again. One of them, (now quoted,) contains, we believe, almost as much as is known practically of photogenic drawing, or at least is performed upon the same principles, and had the priority of publication. The other extract is a most remarkable experiment; and which, at one time, occasioned much discussion, and even yet is not quite satisfactorily explained.

Light, a Painter.—"Strain a piece of paper or linen upon a wooden frame, and sponge it over with a solution of nitrate of silver, (lunar caustic,) in water. Place it behind a painting on glass, or a stained window frame, and the light traversing the painting or figures will produce a copy of it upon the prepared paper or linen; those parts in which the rays were least intercepted being the shadows of the picture."

The Mysterious Circles.—"Cut from a card two discs or circular pieces, about two inches in diameter. In the centre of one of them make a hole, into which put the tube of a common quill, one end being even with the surface of the card. Make the other piece a little convex, and lay its centre over the end of the quill, with the concave side of the card downwards, the centre or upper card being from one-eighth to one-fourth of an inch above the end of the quill—attempt to blow off the upper end by blowing through the quill, and *it will be found impossible.*

"If, however, the edges of the two cards be made to fit each other very accurately, the upper card will be moved, and sometimes it will be thrown off; but when the edges of the cards are, on two sides, sufficiently far apart to permit the air to escape, the loose card will retain its position, even when the current of air sent against it be strong. The experiment will succeed equally well, whether the current of air be made from the mouth or from a pair of bellows. When the quill fits the card rather loosely, a comparatively light puff will throw both cards three or four feet in height. When, from the humidity of the breath, the upper surface of the perforated card has a little expanded, and the two opposite sides are somewhat depressed, those depressed sides may be seen distinctly to rise and approach the upper card, directly in proportion to the force of the current of air.

"Another fact to be shown with this simple apparatus, appears equally inexplicable with the former. Lay the loose card upon the hand with the concave side up; blow forcibly through the tube, and at the same time bring the two cards towards each other, when within three-eighths of an inch, if the current of air be strong, the loose card will suddenly rise, and adhere to the perforated card. If the card through which the quill passes has several holes made in it, the loose card may be instantly thrown off with the least puff of air.

"For the explanation of the above phenomenon, a gold medal and one hundred guineas were offered, some years since, by the Royal Society. Such explanation has been given by Dr. Robert Hare, of the United States of America, and is as follows:—

"Supposing tha diameters of the discs of card to be that of the hole as 8 to 1, the area of the former to the latter must be as 64 to 1. Hence, if the discs were to be separated, (their surfaces remaining parallel,) with a velocity as great as that of the air blast, a column of air must, meantime, be interposed, 64 times greater than that which would escape from the tube during the interim; consequently, if all the air necessary to preserve the balance be supplied from the tube, the discs must be separated with a velocity as much less than that of the blast, as the column required between them is greater than that yielded by the tube; and yet the air cannot be supplied from any other source, unless a deficit of pressure be created between the discs, unfavorable to their separation.

It follows, then, that under the circumstances in question, the discs cannot be made to move asunder with a velocity greater than one sixty-fourth of that of the blast. Of course all the force of the current of air through the tube will be expended on the moveable disc, and the thin ring of air, which exists round the orifice between the discs; and since the moveable discs can only move with one sixty-fourth the velocity of the blast, the ring of air in the interstice must experience nearly all the force of the jet, and must be driven outwards, the blast following it in various currents, radiating from the common centre of the tube and discs."

MISCELLANIES.

Oak Trees for Shipping.—It is asserted, in the "Life of Bishop Watson," that a 74-gun ship requires to build it 200 oak trees of two tons of timber each, and supposing 100 such trees growing on an acre, clears 20 acres of woodland. An acre of oak trees is generally reckoned at 6,760 square yards, or nearly half as much more as the common acre. Mr. Wood observed in the House of Commons lately, that it took 150 men a twelvemonth to build such a ship.

Rarity of the Air.—The atmosphere at the surface of the earth weighs 15lb. on every square inch; at 3½ miles upwards it is twice lighter than at the surface; at 7 miles high it is four times lighter: thus at every elevation of 3½ miles, the atmosphere will be twice lighter than at the preceding. As the air is about 44½ miles high, that quantity which occupies a cubic inch at the surface of the earth, will be expanded so as to occupy a space equal to 812 cubic inches; or if the table be continued till 500 miles of elevation were attained, a single cubic inch of the air we breathe would fill a hollow sphere, equal in diameter to the orbit of the planet Saturn, or 1,822,000,000 miles. There have been various opinions held at different times as to the limits of the atmosphere, and it may be inferred, if not proved, that it is impossible that its rarity can exceed that point at which the repulsive force between its particles becomes less than the force of gravitation. M. Poisson supposed that the limit of the atmosphere, instead of being one of almost insensible gradation, is abrupt and well defined, through a process in the upper regions of the air; no less singular than that of its conversion by cold into a *liquid*, or even a *solid*. This is an extreme and extravagant view of the subject, neither borne out by experiment nor analogy. Our philosophers have

contended, that, as the extra-mundane space is colder than the mean temperature of the air, it must follow, that, at a certain point in the altitude, another region exists, in which the density *increases* with the rarity of the air.

Minute Objects.—The ingenuity of the Germans and others in the construction of minute objects is almost incredible. A cup, made from a piece of ivory of the size of a common peppercorn, by Nerlinger, a German, is said to have held 1,200 other ivory cups having each a separate handle, all gilt on the edges—and besides this there was room for 400 more: but unfortunately for the lovers of minutiæ, the artist died before he had accomplished this microscopic performance.

Myrmecides is mentioned by several ancient authors, for his singular skill in working minute images of marble or ivory—for instance, a carriage so small, that it was covered by the wings of a common fly, together with its driver.

To Extract the Perfume of Flowers.—Procure a quantity of the petals of any flower which has an agreeable flavor—card thin layers of cotton wool, which dip into the finest Florence oil—sprinkle a small quantity of fine salt on the flowers, and place layers of cotton and flowers alternately, until an earthen, or wide-mouthed glass vessel, is quite full. Tie the top close with a bladder, and lay the vessel in a south aspect, exposed to the heat of the sun, and in fifteen days, when opened, a fragrant oil may be squeezed away from the whole mass—little inferior, (if roses are made use of,) to the dear and highly-valued otto, or odour of roses.

Electricity produced by the different Rays of Light.—Professor Saverio Barlocci, of Rome, states, that when two pieces of copper, painted black, and one of them connected with the upper part of a frog, and the other with the hind feet, are placed one of them in the red, and the other in the violet ray of the solar spectrum, and then brought into contact, that contractions took place in the muscles of the frog.

Marking Ink for Linen.—M. Henry, senior, recommends the following as a marking-ink for linen to be employed in hospitals:—Take iron filings, 1lb.; acetic acid (*Vinaigre de Bois*) sp. gr. about 1.052, 2lbs.; mix the iron filings with half the vinegar; shake the mixture frequently, and as it becomes thick, add the rest of the acetic acid, and of water 1lb. Heat the mixture to favor the action of the acid upon the iron; and when it is dissolved, add sulphate of iron, 3lbs.; gum-arabic, 1lb.; previously dissolved in water, 4lbs. Mix them thoroughly while hot; these quantities usually give 12lbs. of product. In order to employ it, the linen is stretched upon a table, and copper characters [stencils?] and a hair-brush are used.

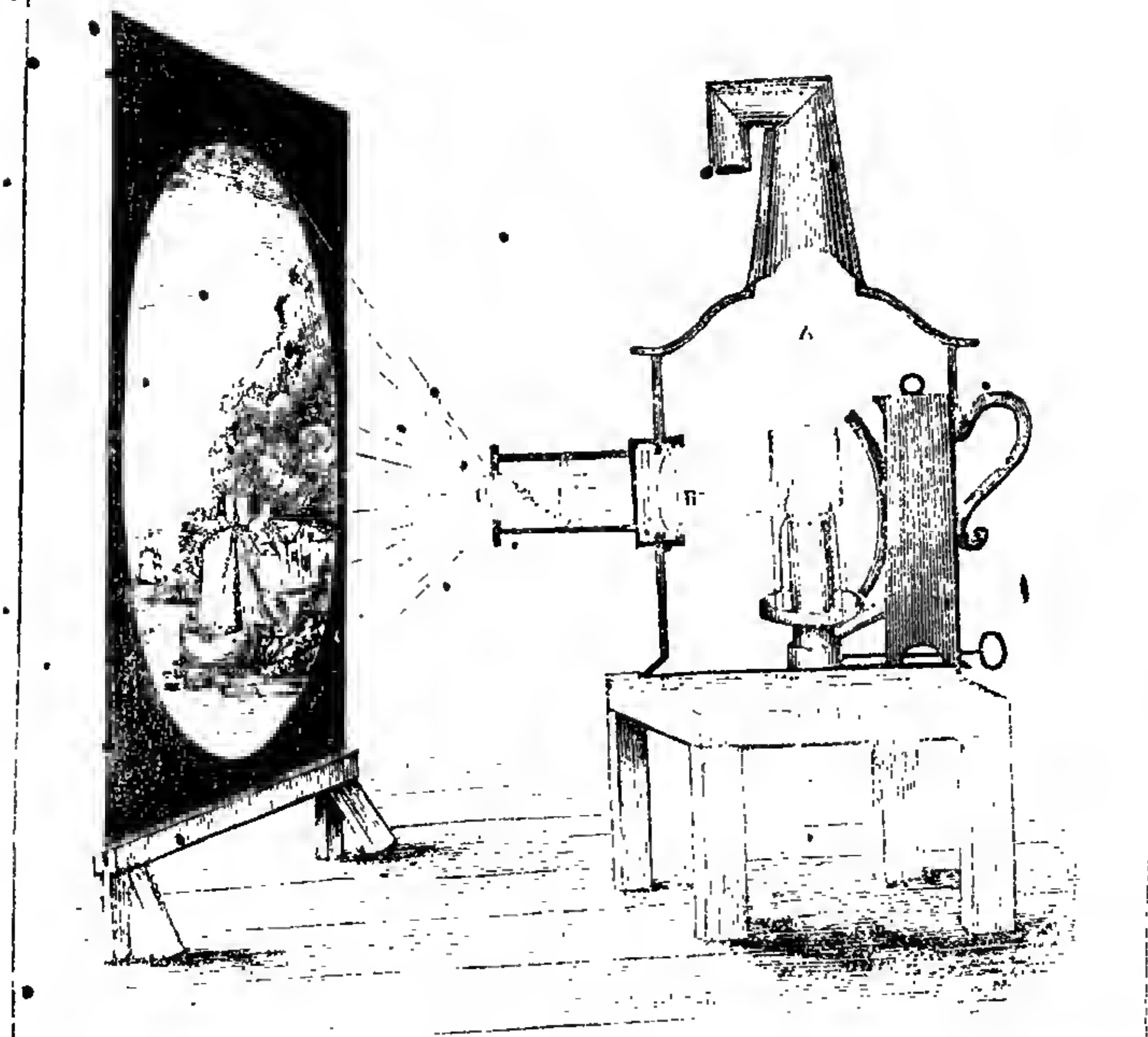
Scintillation of Steel.—When coarse emery is used on polishing wheels, gunpowder will be fired at any distance to which the sparks extend; but when very fine emery is used, a stream of innumerable sparks may be poured upon coarse gunpowder, without inflaming it. The same powder, however, on being finely pulverized, will be readily inflamed by the sparks from the fire-wheel. In both cases, the sparks are particles of ignited iron, and there can be no difference in the two cases, except in the magnitude of the particles. It would seem, therefore, that within certain limits gunpowder would not be inflamed by particles of ignited iron, unless they have at least a certain magnitude in relation to the magnitude of the grains of the powder. This experiment was probably suggested by the fact, well known, that on putting the hand into the stream of sparks, the sensation experienced is rather that of *cold* than of *heat*. This is a fact which not a little surprises those persons who have the courage to present their hands to a stream of fire so dense as to have the appearance of one continued flame. The paradox may probably be explained in the following manner:—

The particles which make up the stream are much smaller in dimensions and fewer in number than they appear to be, each particle, from the extreme rapidity of its motion, appearing to extend several inches, when, in fact, it is little more than a mere point. These particles, being thus minute, do not impart a sufficient quantity of heat to penetrate through the insensible external membrane of the skin, called the cuticle or epidermis, so as to reach the adjacent membrane which alone is the organ of sensation, before it is again withdrawn by the increase of evaporation produced by the current of air which the wheel puts in motion. If the hand is held steadily in the stream until the evaporation is diminished by the gradual desiccation of the skin, we shall perceive a mild sensation of heat. These sensations, first of cold only, and afterwards of mild heat, take place only when we present to the stream the *inside* of the hand or fingers, where the cuticle is thick. If the *back* of the hand be presented, a very pungent and pricking sensation of heat is produced at every point where a particle impinges, highly contrasted, at the same time, with a general sensation of cold, produced by the increased evaporation. In the first case, the heat is passing through the thick cuticle of the inside of the hand, extends laterally, and loses its intensity before it reaches the sensible membrane; but the cuticle on the back of the hand being extremely thin is immediately penetrated.

Note.—The polishing wheels referred to are of various sizes and kinds, from large grindstones, on which the gun-barrels are ground, to small wheels covered with oiled leather and armed with emery powder. All these wheels are moved with great rapidity by strong water power, and when the steel articles are held upon them, there is a splendid coruscation of innumerable sparks flying off in tangent lines, which will follow one another with such rapidity that the wheel is constantly surrounded with a glory.

Power of Carbon to Destroy the Bitterness of Certain Bodies.—M. Duburga observed that charcoal destroyed the bitterness of a tincture of gentian root, whilst it had no action on that of the centaury; in consequence of which observation, Dr. Kopff made many experiments on different bitter substances, and found great varieties of action. Each experiment was made with 2 oz. of distilled water, 20 grains of bitter extract of the particular plant, and about 60 grains of the recently pulverised charcoal; they were digested at temperatures from 78° to 86° Fahr., and examined at intervals, being compared with similar solutions without the charcoal. Wormwood, centaury, gentian, quassia, were not changed; orange-peel, camomile, yarrow, soapwort, and Iceland moss, lost all their bitterness. Endive, rhubarb, &c. &c., were nearly deprived of their bitterness.

When animal charcoal, freed from phosphate of lime, &c., by digestion in muriatic acid, was used in place of vegetable charcoal, similar results were obtained.



MAGIC LANTHORN AND PHANTASMAGORIA.

There are few instruments so generally employed as a vehicle of rational and scientific amusement as the Magic Lanthorn. The galanty show indeed seems as it were engrafted in our earliest recollections of Christmas frolics. For grotesque figures—the terrific phantoms—and the magnificent processions, displayed "all on a white sheet," took too early and too vivid a hold upon our fancies to be easily forgotten—and when we first saw a *Phantasmagoria*, with its ghastly and changing heads—its prominent and apparently-approaching monsters—how we trembled with fear and wonder. Nor were we singular, for when this instrument was first discovered in 1802, the whole world (as the French would say,) were equally struck with astonishment. To witness the wonderful effects, grave as well as gay, the aged and the young, flocked nightly in crowds to the exhibition. Yes—and so they do now too, to see the beautiful and well-managed "*Dissolving Views*" of Mr. Childe; or a "*Lecture on Astronomy*," if illustrated by a good Magic Lanthorn.

In describing and managing this instrument four things require separate attention. The construction of the instrument itself—the medium or screen upon which the objects are to be shown—the painting and combination of the sliders—and the requisite attention to the use and management of the whole. We shall consider the first and last of these particulars now, and the rest at an early opportunity.

A is a tin or wooden box, about eight inches in each of its dimensions, furnished with a bent tin funnel or chimney at top, to carry off the smoke of the lamp which is in the middle. It is furnished also with handles to carry the whole by, and with holes around and near the bottom to feed the flame with the air necessary to its combustion. One side of the box must, of course, be made to open, that the light may be managed. The lamp within side presents nothing peculiar in construction. It is a common Argand burner, but furnished at the back with a concave reflector to increase the intensity of the light. In order to get a good position for the light it should be made to slide backwards and forwards by means of a wire, (as seen in the Figure.) In the front of the box is a tin tube, having in it two lenses, a plano-convex lens or *bull's-eye* B, near the light, and a smaller double-convex lens C, at the end of the tube, further off. The tube is fastened to the lanthorn by a square foot, two sides of which are left open to admit the sliders. The double-convex glass is also made to slide in and out, that the focus may be properly adjusted. In the common construction the slider passes between the

light and larger lens. Such, however, is not the best method; the objects should pass between the two lenses, the *bull's-eye* being fixed to the lanthorn itself, as is represented at B in our figure. In some cases a third lens is admitted between the two others, and supposing a necessity existed of exhibiting phantasmagorially, that is, behind the screen, and in a confined space, it is useful, because of increasing more the field of view, in proportion to the distance between the lanthorn and screen, otherwise it is injurious; for be it remembered in all optical instruments, that the more compound the instrument *ceteris paribus*, the more obscure the image.

The Phantasmagorial Lanthorn differs in no degree whatever from the above, except that the tube holding the lenses is made so as to project beyond the lens C, and the lens itself is made to slide readily and evenly backwards and forwards, either by means of rack and pinion, or more simply by little studs, fastened on each side of it, which pass through the sides of the tubes, and are moved along by means of the finger. Other contrivances for the better effect of the exhibition are not unworthy of attention, particularly that of a flap to shut off the light suddenly: this may be a tin slider placed in a groove close to the lanthorn, or else a piece of tin fastened in the front of all. The square chamber also into which the objects are placed, may and ought to have the top made so as to open upon occasion, for there are many sliders which must be put in at the top, and the eyes of moveable figures are much more easily moved from that position. Again, by the usual construction of the lens, the centre of the field of view is the brightest, and towards the edge the figures are not only dim, but distorted, and that for the same reason as explained when treating of the Camera Obscura.—(*See No.* 1. *Page* 1.) It may be in a great degree remedied by the same means: namely, substituting a meniscus glass for the double-convex lens, or else two lenses, (of a longer focus,) so placed as to touch each other. Another more serious cause of distortion arises from the painting of the sliders, for however experienced and skilful a draughtsman may have been employed upon them, it is rarely but that when multiplied 100 or 1000 times, they appear out of natural proportion. Thus grotesque subjects, rather than those that are elegant, are mostly chosen for exhibition.

It may not be amiss in this place to give a few general and practical remarks on the management of the Magic Lanthorn, and this will offer itself to our attention under different points of view; that is, in reference first to the light, and afterwards to the lenses.

First, consider the distance at which the lanthorn is to stand from the screen, according to the intended size of the figures, and this is easily ascertained by lighting the lamp and suffering the light to be thrown upon the screen, then retiring or advancing with the lanthorn until this has been decided upon. At this spot, then, fix the lanthorn on a table, stool, &c., and at such a height as to throw the circle of light in the centre of the screen or medium. This being done, put one of the sliders in the channel prepared for it, upside down, then adjust the front lens, (which is in a separate tube, capable of being drawn out and in) so as to get as bright a view of it as possible; this will find the focus. Next slide the lamp backwards or forwards, until the light upon the screen is increased to the greatest degree of brilliancy. When *these various adjustments have* been made the apparatus ought to be in order for exhibition, except a trifling re-adjustment of the front lens, which will be necessary on account of the light having been moved. It however sometimes happens that with the greatest care a dimness is observable. If this dimness be over the whole disc of light, it must arise either from the light not burning clearly, or from the lenses being covered with dust or moisture. This will often be the case when it is not suspected. The exhibitor having wiped the glasses well and fresh trimmed the lamp, supposes that these are in order, but this is frequently very far from being the case. That the light burns brightly when the door is open may very likely be the case, because it then has plenty of air, but the door being closed, it is supplied with air much less perfectly, and the light is in proportion duller. The bull's-eye, or plano-convex lens, may have been cleansed previous to exhibition; if this be done when the room is without many persons breathing in it, it looks clear and transmits the light well, but as soon as the room is full of company, ready to see what is going forward, and the exhibitor feels assured of success from his previous trials, behold! he experiences a defeat. In vain he trusts to his late efforts, dimness and obscurity have again to be overcome, and in endeavouring to obviate the inconvenience he too often increases it by altering his adjustments. The cause is this—the plano-convex leos being thick and *cold*, condenses upon its surface the breath of the surrounding spectators, and wiping this is the only remedy. But as at all times prevention is better than cure, the operator should be careful to light his lamp a sufficient time before the exhibition for this lens to get somewhat warm, before he has to use the instrument. The small double convex-lens at the front of the instrument is also liable to become obscure from the same cause, though being thinner, and therefore sooner getting warm, it is not so liable to occasion so great a degree of obscurity. It may in conclusion be remarked, that the field of view on the screen is often apparently clouded at one part of it. This arises from the lamp not being in the centre of the lens, and is a defect in the manufacture of the instrument rather than the management of it. If this cloud be on the upper part, it shows the lamp to be too low, if on the right side, the lamp is too much to the left, and so on for other positions.

Note.—By an inadvertence, not seen till too late for alteration, the plano-convex lens in our drawing has the convex side turned towards the light, instead of the flat side, as should be the case.

PHOTOGENIC DRAWING.

Though a month has nearly elapsed, and we have taken no notice of the extraordinary process of Photogenic or Photographic Drawing, which now occupies such general attention, it has been because we were desirous in this, as in all things else, to test and, if possible, improve upon the experiments suggested by Mr. Talbot, and since pursued by such ardour by all the philosophers and artists of this country, of France, and of Germany. We now, however, proceed to give all the information in our power, having tried all the different receipts published.

History.—It was known in a very early stage of chemical science, that light had the effect of changing the white chloride of silver into the black oxyde of

silver, and by a continuation of its action even into metallic silver.

In an early volume of the Transactions of the Royal Institution the process is first described, and an analogous experiment is found in Hooper's Mathematical Recreations. As the subject is now engaging so much of public attention, we subjoin the substance of the original paper by Mr. Wedgwood, feeling assured that our readers will be pleased to learn how much was done formerly upon this interesting process:—

"An account of a method of copying Paintings upon Glass, and of making Profiles, by the agency of Light upon Nitrate of Silver. Invented by T. Wedgwood, Esq., with observations by H. Davy.

"White paper, or white leather, moistened with solution of nitrate of silver, undergoes no change when kept in a dark place; but, on being exposed to the day light, it speedily changes color, and after passing through different shades of grey and brown, becomes at length nearly black.

"The alterations of color take place more speedily in proportion as the light is more intense. In the direct beams of the sun, two or three minutes are sufficient to produce the full effect. In the shade, several hours are required, and light transmitted through different colored glasses, acts upon it with different degrees of intensity. Thus it is found, that red rays, or the common sunbeams passed through red glass, have very little action upon it; yellow and green are more efficacious; but blue and violet light produce the most decided and powerful effects.

"The consideration of these facts enables us readily to understand the method by which the outlines and shades of paintings on glass may be copied, or profiles of figures procured, by the agency of light. When a white surface, covered with solution of nitrate of silver, is placed behind a painting on glass exposed to the solar light, the rays transmitted through the differently painted surfaces produce distinct tints of brown or black, sensibly differing in intensity according to the shades of the picture, and where the light is unaltered, the color of the nitrate becomes deepest.

"When the shadow of any figure is thrown upon the prepared surface, the part concealed by it remains white, and the other parts speedily become dark.

"For copying paintings on glass, the solution should be applied on leather; and, in this case, it is more readily acted upon than when paper is used.

"After the color has been once fixed upon the leather or paper, it cannot be removed by the application of water, or water and soap, and it is in a high degree permanent.

"The copy of a painting, or the profile, immediately after being taken, must be kept in an obscure place. It may indeed be examined in the shade, but, in this case, the exposure should be only for a few minutes; by the light of candles or lamps, as commonly employed, it is not sensibly affected.

"No attempts that have been made to prevent the uncolored parts of the copy or profile from being acted upon by light have as yet been successful. They have been covered with a thin coating of fine varnish, but this has not destroyed their susceptibility of becoming colored; and even after repeated washings, sufficient of the active part of the saline matter will still adhere to the white parts of the leather or paper, to cause them to become dark when exposed to the rays of the sun.

"When the solar rays are passed through a print and thrown upon prepared paper, the unshaded parts are slowly copied; but the lights transmitted by the shaded parts, are seldom so definite as to form a distinct resemblance of them by producing different intensities of color.

"With regard to the preparation of the solution, I have found the best proportions those of one part of nitrate to about ten of water. In this case, the quantity of the salt applied to the leather or paper, will be sufficient to enable it to become tinged, without affecting its composition, or injuring its texture.

"In comparing the effects produced by light upon muriate of silver, with those produced upon the nitrate, it seemed evident, that the muriate was the most susceptible, and both were more readily acted upon when moist than when dry, a fact long ago known. Even in the twilight, the color of moist muriate of silver spread upon paper, slowly changed from white to faint violet; though under similar circumstances no immediate alteration was produced upon the nitrate.

"The nitrate, however, from its solubility in water, possesses an advantage over the muriate: though leather or paper may, without much difficulty, be impregnated with this last substance, either by diffusing it through water, and applying it in this form, or by immersing paper moistened with the solution of the nitrate in very diluted muriatic acid.

"To those persons not acquainted with the properties of the salts containing oxide of silver, it may be useful to state, that they produce a stain of some permanence, even when momentarily applied to the skin, and in employing them for moistening paper or leather, it is necessary to use a pencil of hair, or a brush.

"From the impossibility of removing by washing the coloring matter of the salts from the parts of the surface of the copy, which have not been exposed to light, it is probable, that both in the case of the nitrate and muriate of silver, a portion of the metallic oxide abandons its acid, to enter into union with the animal or vegetable substance, so as to form with it an insoluble compound. And, supposing that this happens, it is not improbable, but that substances may be found capable of destroying this compound, either by simple or complicated affinities. Some experiments on this subject have been imagined, and an account of the results of them may possibly appear. Nothing but a method of preventing the unshaded parts of the delineation from being colored by exposure to the day is wanting, to render the process as useful as it is elegant."

In a little book published about twenty years ago, called Philosophical Recreations, is an experiment entitled "To write on glass by means of the sun's light" of a similar nature; and another modification of the same process has already been noticed in Parlour Magic, (*see our last number, page* 15.) Besides which, and of more importance to us now, is the knowledge that Sir Humphrey Davy and Mr. Wedgwood were engaged in a course of chemical experiments upon this very subject in 1802, as above detailed, the result of which was so complete a failure, that Sir H. Davy declared as his opinion, that the process could never be made so far successful as to be applied to any useful purpose.

About the same time M. Ritter, and our countryman Dr. Wollaston, were directing their attention to the same subject, not with the same view, but to analyze the rays of light as refracted by a prism; in order to ascertain more fully the relative heating

and decomposing effects of the different ends of the solar spectrum.

The subject from that time ceased to be regarded with any interest, until M. Daguerre, one of the painters of the Diorama, communicated to the French Institute, that he had made a remarkable discovery, whereby he was enabled in an infinitely short space of time, to produce minute and elaborate drawings of the most complicated subjects without aid from the pencil, his only artist being the sun. This account was published in the Literary Gazette of last January as having been read before the Royal Society, where also specimens of M. Daguerre's process were exhibited. These were so beautiful and so accurate in perspective, in sharpness, and in due gradation of light and shade, that all who saw them were astonished. Soon after the above account was published, Mr. Fox Talbot communicated in the Philosophical Magazine, that he also had for about four years been acquainted with a process analogous to that of M. Daguerre—then two Englishmen claimed the invention—then the celebrated botanical draughtsman Mr. Bauer, in behalf of a deceased friend, one M. Naipce, whom it is proved was formerly in connexion with M. Daguerre, and to whom there is no doubt the latter is indebted if not to the completion of his method, at least to a considerable progress towards it, as pictures still remain which belonged to M. Neipce, executed by him so long ago as 1826.

Nature and Effect.—Our process, as originating with Mr. Wedgwood, and so greatly improved by Mr. Talbot, is totally different from that of the French philosophers—their's gives the shadows in their proper places and of their proper depths. Thus the French pictures are accurate representations of nature—the outline is also sharp and well defined; but with ours, as at present formed, the lights and shadows are reserved, that which is brightest in the copy is darkest in the sun-drawn counter-part. There is, moreover a cloudiness about the very best specimens, which, although it often adds to general softness of effect, detracts much from force, expression, and utility. This must, of necessity, be the case, considering the nature of the process, which is as follows:—Paper is imbued or coated with a salt of silver, whence it becomes sensitive to light, not merely the beams of the sun, but the diffused light of day—changing, when thus exposed, from its original white color, first to a violet, and afterwards to various shades of red, brown, or black, according to the time of its exposure, and the strength of the solution of silver washed over it. Now supposing a piece of lace or checked muslin be placed upon this prepared paper, a pane of glass be put over to keep it steady, and then exposed: the rays of light will be partly, if not wholly intercepted by the threads of the muslin or lace, and in these parts the color of the paper beneath will not be changed. Apply the same process to another object; namely, a copper-plate print, or the printed impression of a wood cut—wherever in these is a mass of shade, or a dark line, such will intercept the light, and a white mark will be occasioned on the photogenic paper, the whole picture becoming reversed: thus a lady represented in a copper-plate as with black hair and a fair complexion, would appear in the copy to have white hair and a dark skin—a round ball would seem a hollow cup—a clear bright sky and gloomy mountains would appear like a sunshiny prospect in a thunder storm, when represented by means of Mr. Talbot's process.

To obtain then a copy like the original in shadow, this first copy is to be substituted for the engraving or wood cut, when of course upon a piece of the paper a design like the original in general effect will be produced, though, let it be understood, it will want its sharpness and clearness of detail. Another modification of the process of Photogenic Drawing is that by reflected light from natural objects. In a *Camera Obscura*, (*see page* 1,) objects animate and inanimate are (diminished at will by proper lenses, and according to the distance of the screen,) reflected upon an appropriate and convenient medium. Supposing, therefore, a sheet of photogenic paper be placed at the proper position, it will catch and be altered by the lights thrown upon it, and thus a picture may be formed; and so may also a delineation of any object contained in a *Solar Microscope* be represented on a sheet of the prepared paper fixed properly before it. Artificial light, such as that from candles, &c., has no effect upon photogenic paper, except in circumstances of extraordinary intensity. Paper subjected to the action of that light, occasioned by charcoal points when a stream of the galvanic fluid passes through them, commonly called the *charcoal light*, did not produce even the violet tinge upon the paper until exposed to it for some hours. The *lime light*, or that used in the oxyhydrogen microscope, and formed by a stream of hydrogen thrown upon lime, and urged into intensity of light by oxygen, affects the paper in a few minutes, and depicts the enlarged microscope object upon the screen. It will now be argued, that as the unchanged part of the paper still remains susceptible to light, that will also soon become equally dark with the rest, and the whole rendered useless. Such is the case: and ignorance of the method of *fixing* the pictures occasioned Sir H. Davy to entertain an opinion of the uselessness of the whole, and in fact removed to a great distance in utility his experiments, and those recorded as previous to him, from the modern discoveries.

(*Continued on page* 25.)

FRENCH SHIPPING.

It would be difficult to find a more striking example of the utility of the application of the mathematical sciences to the practical arts, than is to be found in the success of the French nation in ship-building. They are not a maritime people. One of their ambitious sovereigns, however, resolved to make them so, and employed men of science to build ships. He and the subsequent sovereigns of France encouraged them in ascertaining mathematically the best form for ships, and in applying the mathematical sciences to their construction. The consequence has been that the French ships, particularly of their royal navy, are in general equal, if not superior, as to form, to any other ships of the whole globe. We are a maritime people, possessing a more extensive sea-coast, and more familiar with the ocean than any other nation. In the practical and merely manual part of building ships, as well as in managing them, we are superior to our neighbours. That we in general overtook and captured the finest-formed vessels of the French, was a consequence of the superior skill of our sailors; but the superiority of those vessels, as to form, was so great, that most of the ships at present in our navy have been modelled after captured French ships. Now this superiority was altogether derived from the plan of constructing their ships on mathematical principles. Such is,

however, now the progress of scientific instruction in this country, that there is every reason to hope on this point, as on others involving not contention, but emulation, that we shall not be surpassed by our enlightened rivals.

FIRING GUNPOWDER BY THE GALVANIC BATTERY.

VARIOUS methods of firing gunpowder by means of the voltaic fluid were suggested and practised almost as soon as the science itself was known. The first account of such experiments *that were carried to any extent or applied to practical purposes*, is given in the 21st vol. of Silliman's American Journal of Science; and more recent results are given in a paper communicated to the British Association in 1836, in which Dr. Hare mentioned the application of voltaic action to the useful purposes of blasting rocks, &c., using for this purpose the instrument or battery, commonly called the *Calorimeter*. Dr. Hare also mentioned, that the same power might be employed to fire charges of gunpowder under water, though he does not appear to have instituted any experiments to prove the efficacy of the principle. This has, however, been fully accomplished lately by Colonel Pasley, who uses, as the only necessary power, a battery of six or eight pint jars, arranged according to the sustaining principle of Mr. Daniel.

The experiments instituted with these means are now the subject of public discussion and interest: the following, abridged from the daily prints, is an outline of the process, its effects, and probable consequences.

"The Royal Engineers at Chatham, under Colonel Pasley, have repeatedly fired gunpowder at the distance of 500 feet, with their conducting wires, either buried under ground, or led entirely under water, except a few feet immediately connected with the battery, which in their sub-aqueous explosions was in a boat on the Medway, the powder being lodged at the bottom of the river. On Saturday, April 6th, they applied their voltaic battery to the blasting of rocks under water. Two very large and heavy pieces of hard sandstone were prepared and loaded with three quarters of a pound of powder in each. The conducting wires were led from each charge to the battery, which was placed on the gun-wharf, and the stones lowered to the bottom of the river, where the water was fourteen feet deep. Upon passing the shock, the gunpowder was in both instances fired, and the stones split into fragments.

"The results of these and other similar experiments may be of great importance, especially for defensive military mines, because the voltaic battery affords the only possible means of firing several such mines, not only instantaneously, but simultaneously, whereas by the common method of a portfire or fusee, connected with a train of powder, no positive certainty as to time can be calculated upon. For sub-aqueous explosions the superiority of the voltaic battery is still more striking; so much so that Col. Pasley has repeatedly declared that if he had been possessed of the same voltaic apparatus, and had known how to use it, last year in his operations on the Thames, it would have saved a great deal of trouble and expense.

"Nothing can appear easier than to fire gunpowder under water by the voltaic battery, as exhibited in a lecture-room, but the mode usually adopted upon such occasions, of passing the conducting wires into the charge through a cork coated with sealing wax, and of insulating the remaining length of wire in small Indian rubber tubes, is inadequate and inexpedient for practical purposes, in a rapid tide-way and in deep water. In Col. Pasley's experiments at Chatham, corks and sealing wax were rejected—the former as being too weak, the latter from being liable to crack, and Indian rubber was also rejected as being far too expensive; instead of which a composition of pitch, bees'-wax, and tallow, was adopted, the remarkable efficacy of which was proved by keeping one of these experimental charges ten days under water before it was fired, when the powder was still perfectly dry.

"The conducting wires are bound tightly to the different sides of a well-tarred rope, by tarred hempen yarn covering the whole, which thus prepared resembled a single rope, and might be coiled up and veered out as one. One of the most important points necessary was, to prevent all strain acting upon the conducting wires from without, and thereby breaking the very small delicate platinum wire within the charge, which by interrupting the circuit would render explosion impossible."

Colonel Pasley, in the course of his experiments, noticed some important facts relative to the comparison of thick and thin copper wires in passing the shock. He says,

"Copper bell wires, one-sixteenth of an inch in diameter, were comparatively useless, the best conducting wires being those of one-fifth of an inch in diameter, which should always be used for great explosions, and none less than one-eighth of an inch, even for small explosions or for blasting.

The officers who witnessed the experiments were unanimously of opinion, that it would be absolutely impossible to fire gunpowder under water, at the distance of 3 or 400 yards, by six of Professor Daniel's cells, with conducting wires only about as thick as a common bell-wire, as was asserted in a paper on the subject of blasting rocks by galvanism, (published in a scientific journal for the month of May, 1838,) instead of which they think, that to produce ignition by such wires, a battery must be constructed infinitely greater than any one ever made. In their own experiments they never succeeded in firing a sub-aqueous charge, even at a distance of 100 feet, by fewer than eight cells, whereas in using the large wires, the same number of cells was found capable of producing ignition at five times that distance.

The superiority of the voltaic battery over the common electrical machine for these and similar purposes is apparent, considering that it may be used in the open air, even exposed to rain and snow, in all weathers, and that it requires no skill in manufacture, or in management.

To the Editor.

VICTORIA REGINA.

SIR.—Some of your readers may not probably be aware that British Guiana boasts a vegetable production, more splendid, as it is certainly more extraordinary, than any other plant with which the enterprise of British collectors has yet made us acquainted. It is an aquatic plant, called "Victoria Regina," in honor of Her present Majesty, and was discovered by R. H. Schomburgh, Esq., who transmitted the original drawings to the Botanical Society of London, accompanied with a description, which was read before that Society on the 7th of September, 1837,

and of which the following is an abstract, and the cut a representation :—

"While contending with the difficulties nature opposed in different forms to our progress up the river Berbice, we arrived at a point where the river expanded, and formed a currentless basin. Some object on the southern extremity of this basin attracted my attention; it was impossible to form any idea what it could be, and animating the crew to increase the rate of paddling, shortly afterwards we were opposite the object which had raised my curiosity—*a vegetable wonder*. All calamities were forgotten ; I felt as a botanist, and felt myself rewarded. A gigantic leaf, from five to six feet in diameter, salver-shaped, with a broad rim of a light green above, and a vivid crimson below, resting upon the water ; quite in character with the wonderful leaf was the luxuriant flower, consisting of many hundred petals, passing in alternate tints from pure white to rose and pink. The smooth water was covered with them—I rowed from one to another, and observed always something new to admire. The leaf on its surface is of a bright green, in form orbiculate, with this exception opposite its axis, where it is slightly bent in; its diameter measured from five to six feet; around the margin extended a rim, about three to five inches high, on the inside light green, like the upper surface of the leaf, on the outside like the leaf's lower part, of a bright crimson. The stem of the flower is an inch thick near the calyx, and is studded with sharp elastic prickles, about three-quarters of an inch in length. The calyx is four-leaved, each upwards of seven inches in length, and three in breadth at the base; they are thick, white inside, reddish brown, and prickly outside. The diameter of the calyx is twelve or thirteen inches, on it rests the magnificent flower, which, when fully developed, covers completely the calyx with its hundred petals. When it first opens it is white, with pink in the middle, which spreads over the whole flower the more it advances in age, and it is generally found the next day of a pink color—as if to enhance its beauty it is sweet scented. Like others of its tribe it possesses a fleshy disc, *and petals and stamens which pass gradually into each other, and many petaloid leaves may be observed which have vestiges of an anther.* We met them afterwards frequently, and the higher we advanced the more gigantic they became. We measured a leaf which was six feet five inches in diameter, its rim five and a half inches high, and the flower across fifteen inches.

"The rich plant collector who would have this magnificent vegetable production added to his Aquarium, must erect a building which will be to our present buildings for stove aquatics, as Gog and Magog to a Lilliputian. The description given of it leads to the presumption that it is a species of Nymphœa, of which you are aware many tropical varieties are cultivated in this country."

I have underlined a passage in the above quotation for the purpose of remarking, that botanists appear to be wrong in concluding that double flowers are "monsters," and only the result of cultivation. Here is a flower that has evidently never received the care of man, to which the artificial experiments of the florist are unknown, and which appears to be rapidly passing into that state which botanists consider perfectly unnatural. Botanists must revoke their decision on this point, and this for an abundance of reasons, which I have not now time to furnish.

Can you inform me if the "Cinerariæ," natives of this country, are furnished with bracts at regular intervals up the flower stalk—if so, this peculiarity is not noticed by Withering.

With best wishes for the success of your Periodical, believe me truly your's o.

Note.—The above-mentioned splendid plant is beyond all doubt the same that was discovered by Dr. Poppig, in the river Maranon, and described first in a letter, dated March, 1832, and fully explained in a German journal, in November of that year, under the name of *Euryale Amazonica*. Its new name then, unless retained by the consent of Dr. Poppig, must be given up. The English Cinerariæ have no bracts; which are properly small leaf-like appendages that accompany the flower, and are therefore found only on the flower-stalk or peduncle, as in the violet. The Cineraria palustris is a much branched plant, and bears nothing that can be taken for bracts. In the Cineraria campestris, (or Cineraria integrifolia of Withering,) the leaves become gradually smaller up the stem, and, as our correspondent says, are at nearly equal distances, but the regular gradation of the leaves in size and shape, as well as their being borne at a distance from the flowers, shows that they are not bracts.—Ed.

WAXEN FRUIT.

There are three distinct processes in making Fruit and other objects in wax. 1st.—The requisite moulds. 2nd.—Casting the fruit in those moulds. 3rd.—Coloring and otherwise finishing the castings.

The first of them is generally considered the most difficult, and the more so because the teachers of this art seldom instruct their pupils in making the moulds ; but, on the contrary, if they know how, and this is not always the case, purposely omit it, that there may be a sale for those they have for disposal. Nothing, however, can be more simple than the method and the materials employed; the latter indeed consist only of a little grease and superfine plaster of Paris, (which may be procured at any of the Italian plaster figure makers, at from 6*d*. to 9*d*. per half bag of 7lbs., which quantity will make several moulds,) a basin, spoon, table-knife, garden-pot full of damp sand, a sheet of thin tin, cut into strips of three inches wide, and some string. Thus furnished set to work.

Suppose we desire a mould for an apple, and we have a real one to mould from, press down the apple into the damp sand, until very nearly one-half of it is buried, that is until the sand reaches to the thickest part: in an apple this would be near the middle; in a pear near one end, unless it were put sideways, when in this case it would also be one-half. An apple must not be put side-ways, because it would not then deliver, that is when the upper part is surrounded with the hardened plaster, as it is soon to be, it cannot be drawn out, on account of a depression there generally is at the stalk and eye of

an apple; but by placing it the other way, that is either stalk or eye end downwards, this difficulty is avoided. In making moulds of every description this is above all things to be observed; even in such simple objects as those now under consideration it is of the utmost necessity. But to proceed—The apple being nearly half sunk in the sand, bend one of the pieces of tin into a hoop, so as to be an inch or inch and a half larger across than the apple; tie a piece of string around it, and place it over the apple, forcing its lower edge into the sand, so as to hold it firmly. Pour water into the basin till it is three-parts full, and into the water *sprinkle* some of the plaster of Paris, sufficient, to make one-half the mould; pour off the superfluous water, stir up the mixture, and put it carefully over the fruit. This being properly of the consistence of thick cream, will run into every minute depression, and completely cover up that half of the apple exposed above the sand, while it will be prevented from flowing away by the rim of tin around.

In a minute or two the plaster will become sufficiently set, or hardened, to be handled. When this is the case remove the tin, and take up the fruit out of the sand altogether, there being now one half of the mould cast. This must be trimmed with a knife for the sake of appearance; and particularly where the sand has touched cut carefully smooth at the exact half of the fruit, for it will have been observed, that as the apple was not quite half buried in sand, the part of the mould now cast will be rather more than half, a small part being allowed for cutting away evenly. Now make a hole or two, or a few notches on one side of the cast where the other is to join it: grease well or soap well this part, holes and all, and tie round it tightly, one of the pieces of tin; the fruit will now be in the same position, in respect to the half mould, as it was when in the sand, except that it is now the other end upwards. The only thing remaining to be done, is to pour plaster upon this other end, and the mould will be complete except a little trimming, which it will require. The parts will easily separate at the joint, and taking out the real fruit, a cavity will of course be in its place, of the exact size and shape, ready for, afterwards, filling up with wax.

Those fruits which have hard or rough skins require greasing, to prevent the plaster sticking to them: this is the case with the Peach—the Apricot—the Walnut, and other nuts—the Almond, &c. &c. There are some few fruits which require the mould to be in three pieces, as very often the Melon, the Mulberry, and Blackberry. Other fruit are never made in wax; as Grapes, Currants, and many more of the smaller kinds, on account of the trouble of joining them together afterwards in bunches,

The principal objects manufactured in wax for ornament, are fruits—various articles of pastry—eggs—peas in the pod—capsicums—dolls—minature busts—flowers—leaves, &c., of these we shall have more to say hereafter, as well as casting moulds for other purposes.

(*Continued on page* 60.)

REVIEW.

Spectacle Secrets. By George Cox.

THIS work, small as it is, contains more real sound sense than one half the folios published. It gives an account of the structure of the eye—offers really good advice to those whose sight has been impaired either by age, sickness, or studious employments, on the choice of that very important instrument, a pair of spectacles, and concludes the subject by exposing, with no sparing hand, the knavery and ignorance of the Jew vendors, and the irreparable injury likely to accrue to those silly persons, who, knowing nothing of the matter themselves, trust blindly to puffing and dishonest advertisements. Every page of the work shows the scientific and practical knowledge Mr. Cox has of these things. The following remarks cannot be too widely distributed:—

"The eyes, when in a sound and healthy state, instinctively adjust themselves at a distance of twelve inches from a book or paper, when they are observing the same. This distance is found to be most natural and agreeable; for when we extend it to sixteen, twenty, or thirty inches, the crystalline lens is stimulated to keep a distinct and clear perception, until, as the distance increases, the object becomes less and less perceptible. When we are compelled to extend this natural distance, experience difficulty in reading small characters, or find it necessary to get more light on what we are observing, we may safely conclude that artificial assistance is needed, and that, judiciously applied, the tendency to decay will be mildly arrested.

"The design of spectacles is to supply the loss of power which is experienced by the eyes at different periods of life, and arising from various causes. These productions of art are constructed with a close observance to, and act upon the same principles as those by which the process of vision is regulated.

"Spectacles ought not to do more than maintain or preserve to us the capability of seeing at the natural distance. This is, in fact, all they are intended to effect. When the crystalline lens of the eye losing its convexity, fails to converge the rays of light, and bring them to their natural focus on the retina, an artificial lens, of suitable convexity, supplies to it this capability, and compensates for its gradual diminution of capacity. Thus lenses for assisting the sight are fashioned upon the optical principles so apparent in the mechanism of the eye itself, which, it will be observed, is neither round nor flat, but of that nicely-moulded convexity which is indispensable for the performance of its functions. If lenses were either spheres or planes they likewise would be ineffective for the purpose proposed.

"Brazil pebbles, or crystallized quartz, are imported to this country in rough blocks; these are cut or slit, by the aid of pulverized diamond, into slabs or pieces of the diameter required. Those pieces in which bubbles, waves, or blemishes appear, are thrown aside by the optician who is tenacious of his fair fame, as their imperfections become more apparent in every after-stage of their progress; and when polished, centred, and shaped for the spectacle-frame, they are really improper to be used at all; nevertheless, the needy, or dishonest, rather than lose a fraction of their gains, often persist in working-up such imperfect material, and harping upon their being pebble—palm them off upon the uninitiated as genuine articles. Pebbles have the following important advantages: they are of equal density, and exceedingly hard, firm, and clear; their surfaces are not liable to become misty or scratched, (which circumstance alone often compels a change of glasses;) they are of a pure, cool nature, and show this contrast to glass, (which is, on the contrary, produced by the action of artificial heat,) in the touch of their finger or tongue to their surfaces.

They are, in consequence of these properties, calculated to suit the sight for a longer period than glass; but they need not be thrown aside, when, from the indications already referred to, we find an increase of magnifying power is required, as they can be re-worked readily enough to meet the requirement of the eyes, and at an expense scarcely more than a new pair of glasses, or about one-third of their original cost.

"This consideration should weigh with those who are apt to be misled by the pretensions of the unprincipled; for pebbles have, in common with many other crystals, a double refracting property, which, if the pebble is cut carelessly, exhibits itself by painfully affecting the vision; two objects, instead of one, are seen, causing a confused and agitating sense of indistinctness, which, in proportion to the exertion of the eye to overcome it, is the more tiresome and distressing. Such faulty and blemished articles, technically called *wasters*, are refused by the optician of any real respectability and character, but are eagerly bought up by those vendors, whose object is to purchase what costs them the least money, alike ignorant of, and indifferent to any other consideration.

"Lenses worked by mechinery are produced in greater quantities, within a given time, than those worked by hand. They are passed through the different stages of grinding and polishing without having the keen eye of the workman carefully watching their progress, and adjusting the inequalities in their surfaces or edges, which will always appear more or less in the course of working.

"Women and children are chiefly employed to cut and edge those cheap glasses to the spectacle frames; and who can expect they should do them better for the price? And if one glass should be unequally thick, like a wedge, while its companion in the same spectacles is miserably thin; or if the centres, instead of being equidistant from all parts of the rim are nipped into a corner; how can you feel surprised when you consider, that for them to earn a living, it is necessary they should finish several dozen pairs per day; and, therefore, expedition, rather than excellence, is the point at which they aim? In many departments, where machinery has supplanted manual labour, the work produced is of a superior character, and will bear more critical examination; but the contrary is the fact in the case of machine-worked optical glasses, and is more especially apparent in such as are intended for microscopic and achromatic purposes. And it cannot be denied that, for all such uses, lenses worked by hand, with the ordinary care of a skilful workman, as much excel those produced by machinery, as the accurate and scientific touch of the artist eclipses the random splash of the plasterer."

MISCELLANIES.

Theatrical Incantations.—Dissolve crystals of nitrate of copper in spirits of wine. Light the solution, and it will burn with a beautiful emerald-green flame. Pieces of sponge soaked in this spirit, lighted, and suspended by fine wires over the stage of theatres, produce the lambent green flame now so common in incantation scenes. Strips of flannel saturated with it, and applied round copper swords, tridents, &c., produce, when lighted, the flaming swords and fire-forks, brandished by the demons in such scenes. Indeed the chief consumption of nitrate of copper is for these purposes.

On Spurious China Ink.—Six parts of isinglass are to be dissolved in twice their weight of boiling water; and also, in two parts of water, one part of Spanish liquorice. The two solutions are to be mixed whilst warm; and incorporated, by a little at a time, with one part of the finest ivory-black, by the help of a spatula. When the mixture has been perfectly made, it is to be heated in a water-bath, till the water is nearly evaporated; and a forms a paste, to which any desired form may be given, by moulding it, as usual.

The color and goodness of this Ink will bear a comparison with the China ink, or, as it is commonly termed, Indian ink.

Pressure of the Sea.—If a piece of wood, which floats on the water, be forced down to a great depth in the sea, the pressure of the surrounding liquid will be so severe that a quantity of water will be forced into the pores of the wood, and so increase its weight that it will be no longer capable of floating or rising on the surface. Hence the timbers of ships, which have foundered in a deep part of the ocean, never rise again to the surface like those which are sunk near the shore. A diver may, with impunity, plunge to a certain depth in the sea; but there is a limit beyond which he could not live under the pressure to which he is subject. For the same reason, it is probable, that there is a depth below which fishes cannot live. They have, according to Jouselin, been caught in a depth at which they must have sustained a pressure of 80 tons to each square foot of the surface of their bodies.

QUERIES.

1—How are waxen fruit and flowers made?—*Answered on page 22.*

2—What is that substance called British gum, which is so much used by calico printers?—*Answered on page 32.*

3—What is the preparation for milk of roses?—*Answered on page 32.*

4—Why does a cat always fall upon her feet?—*Answered on page 56.*

5—A red rose, exposed to the fumes of sulphur, soon becomes white. What is the reason of this?—*Answered on page 32.*

6—Whence arise the different forms of flakes of snow?—*Answered on page 32.*

7—What occasions the luminosity of the ocean?—*Answered on page 56.*

8—How are the dissolving views of Mr. Childs managed?—*Answered on page 271.*

9—Is it possible to freeze pure alcohol? [No.—Ed.]

10—Has climate or time any effect upon alcohol when kept closely stopped up in glass bottles? [None whatever.—Ed.]

11—How is aromatic vinegar made?—*Answered on page 56.*

12—Why is air always blown from an electrified point?—*Answered on page 104.*

13—Has thunder any effect upon beer—and if so, why?—*Answered on page 56.*

14—Do vegetables generate earth?—*Answered on page 56.*

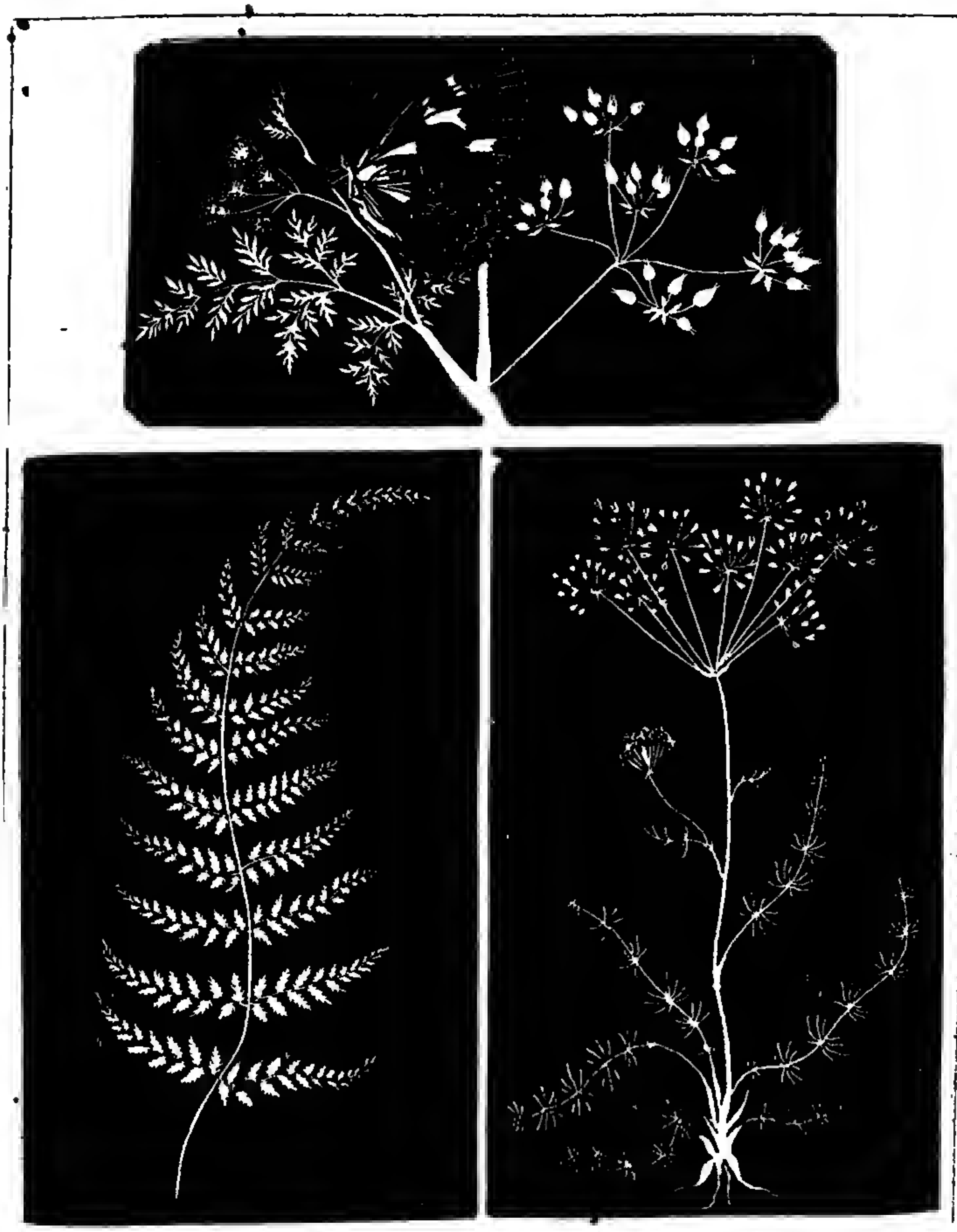
15—Is color a property of matter or of the mind?—*Answered on page 56.*

16—It is said that wheat will not flourish near a barberry bush. Is this a fact? If it be, by what author is it mentioned, and what is the reason of it?—*Answered on page 56.*

17—What is cold cream, and how made?—*Answered on page 32.*

18—Is light a substance or a force?—*Answered on page 56.*

19—How deep does light penetrate into the ocean, and what becomes of it when it can go no lower?—*Answered on page 56.*



FAC-SIMILES OF PHOTOGENIC DRAWINGS.

PHOTOGENIC DRAWING.

(Resumed from page 20.)

IN our last Number we gave briefly the history, and some account of the nature of photogenic drawing; enough, it is hoped, to induce our readers to pursue the subject further, and to follow us through its details and applications.

Materials.—The first difficulty to be overcome is making the prepared paper; and although giving a receipt for it is easy enough, it may not be found so easy to accomplish the process, remembering that that paper alone can be considered good which is quite uniform in tint, and sensitive to a diffused light. There have been numerous methods proposed, and receipts given, of different degrees of efficacy. The same principle, however, is pursued through them, and the same precautions necessary in the manufacture. First, the various washings must be spread on evenly, that, as much as possible, uniformity of tint may be produced; the paper must not be made nor dried, or afterwards exposed incidentally to daylight, or its color will be changed. That side of the paper washed over must be marked, that it may be afterwards known; and the last time it is washed must always be with the solution of silver. The paper used must be of even texture, not partially bibulous, like printing paper, but either so absorbent, as to be completely saturated with the solutions, as white blotting paper, or copper-plate paper, when the preparation of it becomes expensive; or card-board; or else paper with a hard, well-sized surface, such as bank post paper, drawing paper, thin laid foolscap, &c. &c. With all the care, however, as to choice of materials and manipulation, certainty of success cannot be insured. Some sheets of paper will act uniformly, and become of the requisite dark mulberry hue; others, prepared at the same time, and in precisely the same manner, will appear in blotches sometimes darker than the general surface: at other times, spots, or streaks of white, will appear upon them. The color assumed by the paper generally, will depend upon the strength of the nitrate solution; when this is weak, a violet tint will be apparent: a stronger solution causes it to appear in various shades of brown, purple, or black.*

RECEIPTS.

Mr. Talbot's First Method.—"Take superfine writing paper, and dip it into a weak solution of common salt, and wipe it dry, by which the salt is uniformly distributed throughout its surface. Then spread a solution of nitrate of silver on one surface only, and dry it at the fire. The solution should not be saturated, but six or eight times diluted with water: when dry the paper is fit for use." Mr. Talbot says, "This paper, if properly made, is very useful for all ordinary photogenic purposes. For example, nothing can be more perfect than the images it gives of leaves and flowers, especially with a summer's sun, the light passing through the leaves delineates every ramification of their nerves.

"To render this paper more sensitive, it must be again washed with salt and water, and, afterwards, with the same solution of nitrate of silver, drying it between times. I have increased the sensibility to the degree that is requisite for receiving the images of the camera obscura.

"In conducting this operation, it will be found that the results are sometimes more, and sometimes less satisfactory, in consequence of small and accidental variations in the proportions employed. It happens sometimes that the chloride of silver is disposed to blacken of itself, without any exposure to light. This shows that the attempt to give it sensibility has been carried too far. The object is to *approach* to this condition as near as possible without *reaching* it, so that the substance may be in a state ready to yield to the slightest extraneous force, such as the feeble impact of the violet rays when much attenuated."

In this process the salt of muriate of soda is acted upon by the nitrate of silver, and both salts become decomposed. The silver held in solution by the nitric acid, having a greater affinity for the chloric, or muriatic acid of the salt, unites with it, and forms muriate, or chlorate of silver, while the nitric acid and soda are set free. These uniting together, form the nitrate of soda, which is very soluble in both cold and hot water.

Mr. Cooper's Receipt.—"Soak the paper (he prefers *laid* or water-marked paper) in a boiling hot solution of chlorate of potass for a few minutes; the strength of the solution is of little consequence: then take it out, dry it, and wet it with a brush on one side with nitrate of silver, sixty grains to an ounce of water, or if not required to be very sensitive, thirty grains to the ounce will do." This paper has a very great advantage over any other, for it can be fixed by washing with *common water*. It is, however, very apt to become discolored, even in the making, or shortly afterwards, and is, besides, not so sensitive, nor becomes so dark as that made with common salt.

If complete chemical decomposition be aimed at, the proportion of the various ingredients should be according to the laws of chemical affinity, and by taking out of the scale of equivalents the atomic weights of the compound salts used, it will be found that the strength of the various solutions should be to the ounce of water, as thirty grains of nitrate of silver to ten grains of salt, for in these proportions they completely neutralize each other.

M. Daguerre's Method.—"Immerse a sheet of thin paper in hydrochloric (or as it is commonly called muriatic) ether, which has been kept sufficiently long to have become acid: the paper is then carefully and completely dried, as this is stated to be essential to its proper preparation. The paper is then dipped into a solution of nitrate of silver (the degree of concentration of which is not mentioned), and dried, without artificial heat, in a room from which every ray of light is carefully excluded. By this process it acquires a very remarkable facility in being blackened on a very slight exposure to light, even when the latter is by no means intense. This paper rapidly loses its extreme sensitiveness to light, and, finally, becomes not more readily acted upon by the solar beams, than paper dipped in nitrate of silver only."

Mr. Golding Bird's Method.—This is a modification of Mr. Talbot's process: It consists in using 200 grains (nearly half an ounce) of salt to a pint of water—soaking the paper in it—taking off superfluous moisture between the folds of bibulous paper, or by a cloth; while still damp, to be washed on one side with a solution of twenty grains of fused nitrate of silver (lunar caustic) in an ounce of water, and hung up in a dark room to dry. This, Mr. Bird observes, produces a rich mulberry tint.

* It is to be observed, that great superiority is obtained by using the chrystalized nitrate of silver in all the following receipts, rather than the fused nitrate sold as lunar caustic.

Mr. Talbot's Second Method.—"Wash the paper over first with nitrate of silver—then with bromide of potassium—then with nitrate of silver again—drying it at the fire after each operation. This paper is very sensitive to the light of the clouds, and even to the feeblest daylight." This paper, though it may be excellent, cannot ever be of general use, on account of the very great price of bromide of potassium.

Besides the above papers, there are some made upon a different principle, not dependant upon the action of one compound salt upon another, but upon the well-known effect produced upon nitrate of silver when exposed to light, in contact with animal matter. All are aware of the discoloration occasioned by the application of this salt, when used as a caustic to destroy warts, &c. For example, applied to the human skin at night little change will take place till day-light, but afterwards the skin will become black. In pursuance of this well-known fact, it has been suggested to wash paper first with white of egg, isinglass, or glue, and afterwards with nitrate of silver. We have tried these and have found, of the above three ingredients, white of egg is the only one available and really useful. Photogenic paper made by its assistance is not immediately sensitive to light, but after a few minutes exposure to the *direct* rays of the sun it becomes brown, and its color continues to increase for two or three hours, until at length it is of a very fine beautiful chocolate, infinitely finer, and more glossy than the very best of the other kinds. Whatever paper is used it *always* becomes by this method uniform in tint throughout; and the pictures, though somewhat tedious to produce, may, without being fixed, be exposed for a short time even to sun-light, without injury. This egg paper, which is very excellent for transparent objects, such as lace, flowers, &c., has a serious inconvenience, it acts very imperfectly if not exposed to the direct light of the sun, and is, therefore, comparatively unserviceable with the camera obscura, or to transfer prints, &c.

To make the Drawings.—Place upon a flat surface a piece of the photogenic paper, with the prepared side upwards, upon this the object to be delineated, and cover it with a piece of flat glass, (plate glass is the best); expose this to diffused daylight, or still better to the direct rays of the sun, when that part of the paper not covered with the object will immediately become tinged with a violet color; and if the paper be good, in a few minutes pass to a deep brown, or bronze black color. It must then be removed, as no good will be obtained by keeping it longer exposed; on the contrary, the delicate parts yet uncolored will become in some degree affected. The photogenic paper will now show a more or less white and distinct representation of the object chosen.

It must be evident, that the closer the contact of the paper and object the finer will be the outline. To accomplish this it is common to take a book cover, or a piece of wood, and lay upon it first three or four folds of flannel, or what is better, a pad of cotton wadding, the paper, object, and glass upon this, and to tie them together as tightly as possible, or else to place moderately heavy weights upon the corners of the glass. This contrivance, or something similar, is absolutely necessary. Suppose, for example, we have a daisy flower as an object, the centre of the flower is so thick that it will bear up the glass from touching the rest of the flower consequently the stalk, and still more so the delicate white petals or flower leaves will not touch the prepared paper beneath, and the effect of sharpness of outline destroyed. Another suggestion is also called for. When the object, &c., is offered to the sun it should be in a position perpendicular to his beams, or a distortion of parts is liable to occur if of irregular body.

The objects which appear to be delineated with best effect are lace, especially black lace—printed and checked muslins—feathers—dried plants, particularly the ferns, the sea-weeds, and the light grasses—impressions of copper-plate and wood engravings, if they have considerable contrast of light and shade, (these should be put face downwards,) figures painted on glass, such as on magic lanthorn sliders, stained windows, &c.

(*Continued* on *page* 28.)

APPLICATION OF PHOTOGENIC DRAWING TO WOOD ENGRAVING.

Sir.—I send you three drawings of this new art, *which were impressed at once on box-wood,* and therefore are fit for the graver, without any other preparation. I flatter myself that this process may be useful to carvers and wood engravers, not only to those who cut the fine objects of artistical design, but still more to those who cut patterns and blocks for lace, muslin, calico-printing, paper-hangings, &c., as by this simple means the errors, expense, and time of the draughtsman may be wholly saved, and in a minute or two the most elaborate picture or design, or the most complicated machinery, be delineated with the utmost truth and clearness.

The preparation of the wood is simply as follows: place it face, or smooth-side downwards, in a plate containing twenty grains of salt, dissolved in an ounce of water; here let it remain five minutes, take it out and dry it; then put it, also face downwards, in another plate containing sixty grains of nitrate of silver to an ounce of water; here let it rest one minute, when taken out and dried it will be fit for use, and will become on exposure to light of a fine brown color. Should it be required more sensitive, it must be immersed in each a second time, for a few seconds only. It will now be very soon affected even by a very diffused light.

Two other wood blocks of a different nature I will send you shortly.

April 8th, 1839. G. F.

[The three wood-cuts mentioned above illustrate the present paper; as well as the general character of photogenic drawings. The flower on the right hand is the *Carum verticillatum*, or Whorl-leaved Carraway, a pretty but rather uncommon British plant. The other is a Fern, called *Cystopteris fragilis*, also a British plant, and one of a class particularly adapted to photogenic illustration. The other wood blocks we have received. They are now in the hands of our engraver, and intended for the embellishment of our next number.—Ed.]

CASKS TO LIVE IN.

The dimensions, form, and materials of human habitations in different ages and countries, afford endless and sometimes singular varieties. The snow-hut of the Laplander, the tent of skins of the Tartar, the bamboo cottage of the native of Indostan, and the mud hovel of the wretched Irish, are not more varied than some which our own country has lately produced. At Shadwell is a house covered almost entirely with zinc. At Glasgow some have

lately been erected of iron, and as if to crown all, in despair of any new material, a cooper of London has lately realized tha well-known and extravagant story of Diogenes in his tub, and has positively shown that a tub is no bad habitation. He has constructed and exported to Antigua, and elsewhere in the West Indies, immense vats, which are made as casks are; that is, round or oval, with two heads: when the cask is properly formed and hooped, a door and windows are cut in it, aud in some instances a floor has been put half way up so as to divide it into two stories, and these into small rooms, by partitioning. The maker says that where hurricanes are frequent, these houses are serviceable, for if blown down they will *but* roll about—not very pleasant perhaps to the inmates, nor yet very preservative to their crockery, and other goods and chattels; but as he justly observes, are very convenient to remove to another neighbourhood, as it is only necessary to knock the house down, roll it along, and then turn it upright again.

THE RATES OF CHRONOMETERS.

BY CAPTAIN M. WHITE, R.N.

It is a circumstance now well known to all those versed in the management of time-keepers, (though hitherto altogether unnoticed by any navigator,) that the rate assigned to any particular chronometer, whilst on shore, will undergo an almost immediate change on embarkation, uninfluenced by any apparent cause; and that the original shore rate will, on some occasions, be resumed by the same watch, or nearly so, after disembarkation, notwithstanding the partial derangement the rate may have experienced whilst sojourning afloat.

That any alteration should take place in the rate of a time-keeper, in consequence alone of its transition from *terra firma* to ship-board, may perhaps appear somewhat singular; nevertheless, such is indisputably the case, which clearly evinces the operation of some cause, not common to both positions; for if the variation in question could be ascribed, either solely or conjunctively, to mutation in density or change of temperature, the rates of two contiguous chronometers, constructed alike, would be in such cases mutually accelerated or retarded, which they certainly are not found to be; and for a similar reason, it cannot wholly be laid to the operation of friction, as the rates would then generally recede; and as fine weather does, in a superlative degree, neutralize the effects of both density and friction, the rates should then at least become steady, which does not appear to be the case. Some other cause, therefore, must be sought for to account for it.

During my survey of the British Channel and Atlantic, in his Majesty's ship, Shamrock, I was necessarily called upon to bestow a considerable share of attention upon the march of chronometers, not only when in their quiescent state on shore, but also when under all the different vicissitudes incidental to water-carriage, and which was followed up with great perseverance and anxiety during a period of thirteen consecutive years, the results of which have fully convinced me, that this phenomenon is alone to be ascribed to tha action of terrestrial and of local attraction upon the motion of the balance when in different parts of its amplitude, occasionally combined with that of friction upon the pivots of the verge, arising from the motion of a ship at sea, which not only create an erratic propensity in the rate of a time-keeper, independent of every other cause, but do also, in some instances, produce opposite results on two different watches at the same time, though both are situated precisely under corresponding conditions, as to construction and relative position. In extreme cases, this deviation has fallen very little short of 3 sec. 7 in 18 hours, though, when divested of excess, it has remained constant at 1 sec. 37 in 24 hours, in the latitude of 51 deg. 25 min. north—a quantity altogether too considerable to be placed to the account of defects in observation, since mean time can always be obtained within the error of half a second; and this quantity has been found to be greatest when on the meridian; least, when at right angles to it; and to increase and decrease between the east and west points, and the meridian as the cosiness in the table; varying also in arithmetical proportion with the latitude. The above anomaly (however mysterious it may appear) is really neither inconsistent nor inexplicable, nor, indeed, wholly irremediable, if we consider that the steel balance, of even an ordinary watch, will always exhibit polarity, in a greater or less degree: of course, it follows, that if such a balance were wholly isolated from the machinery connected with it, and permitted freely to range, it would gradually resolve itself into the direction of the magnetic meridian, and where, also, if not disturbed, it would eventually become stationary. Now, the same reasoning will equally apply to the balance of the chronometer, although the susceptibility of the different materials pertaining to it, may render the demonstrations somewhat more complex. Admitting, then, the relative association between the elastic force of the pendulum-spring and the limits of the semi-arcs of vibration to have been complete in the construction of a chronometer, (a coincidence, however, which, according to the opinion of the first artist in London, is scarcely ever to be obtained;)—admitting, also, the balance to be of such dimensions as to allow of the greater and lesser vibrations being performed in equal times; yet, perfect isochronism in the measurements of such a balance, neither can nor ought to be expected, even on shore, unless the relative direction of a straight line, drawn from the verge through the centre of oscillation of tha balance coincides with the Northern Pole thereof, as well as with the direction of the magnetic meridian, or unless the said line is in diametric opposition to both. Every other position will cause the semi-arcs of vibration to diverge unequally from the point of quiescence, and alterations in the rate will take place consequent upon such inequality. Still less, therefore, are we to look for such precision afloat, where, to the effects of terrestrial magnetism (of itself constantly varying) must be superadded those arising from local attraction and the motion of the ship; for though the very ingenious escapements now in use diminish, in an eminent degree, the effects of friction upon the works of a chronometer, whilst it continues in a quiescent state (and to which, I presume, the late Count Bruhl meant to confine himself,) yet the complete removal of this inconvenience, where the watch is exposed to the agitation of either land or water-carriage, can never be wholly accomplished, since its operations do not, as when at rest, depend upon the weight and collision of the works alone, which produce steady and uniform pressure in a vertical and horizontal direction, but is derived from the impetus conveyed to it by the motion, which at the extremities of a

ship is always unsteady, and acts capriciously in every direction.

Now it follows, that if these disturbing forces are allowed to exist at present, they must have existed heretofore, and that consequently the rates of all chronometers, down to the present period, and the longitudes deduced therefrom, must have been more or less affected by them, in proportion to the activity or apathy of the magnetic density inherited by the balance; and though it cannot be denied that the meaned results of numerous astronomical observations, corrected by comparisons with intermediate stations, whose localities have been previously determined, carried on from time to time, and brought to bear in regular succession on the rate of a time-keeper, will, by such continual division and subdivision, tend to mitigate the effects of this digression, in common with others; yet it cannot be said by such a process, either to have been distinctly accounted for, or effectually got rid of. The errors are by these means only averaged, not removed. Yielding with great deference to those whose superior management (under all the excessive trials to which their instruments must have been exposed,) has enabled them to exhibit such uncommon regularity and symmetry in their observations, I now submit such conclusions as have been derived from actual experiments, and with that degree of confidence which it is presumed a thirteen years' apprenticeship may entitle them to.

1st.—If a time-keeper is so situated when on ship-board, as that that part of the balance possessing northern polarity shall coincide, with a line drawn from its axis through its centre of oscillation—with the direction of the magnetic meridian, and with that of the ship's head—the rate of that watch will certainly be augmented; because, as the influence of all the forces do, in this instance, unite in the same direction, (with the exception of the local attraction, which evinces no energy whilst in the meridian,) the northern pole of such a balance will be continually striving to approach the point of quiescence, and the range of the semi-arcs of vibration will, in consequence, be proportionally diminished.

2ndly.—If a time-keeper is so situated, as that that part of the balance possessing northern polarity shall coincide with a line drawn from its axis through its centre of oscillation, and with the direction of the ship's head, but rests in an opposite direction to that of the magnetic north, the rate of that watch will as certainly be retarded: because the northern pole of the balance, impelled by a corresponding attraction and repulsion, when receding on either side the point of quiescence, (the local attraction being in this, as in the former case, evanescent,) will make continual efforts to regain its natural position, and the semi-arcs of vibration will, in consequence, be proportionally augmented.

To exemplify this—suppose a ship, furnished with such a time-keeper, departs from Cape Clear, to go to St. Antonio, with a fair wind and fine weather, and suppose the voyage thither to occupy 24 clear days, 576 hours. The main magnetic force from the former to the latter is about S.W. ½ S., which, according to the ratio of increase and decrease before mentioned, will produce a daily loss of 1 sec. 059 in the latitude of Cape Clear, which being reduced for the decrease in the latitude, will produce a loss of 24 sec. 499 during the voyage—thus placing St. Antonio 6 min. 7 sec. 48 out of its true longitude, if no allowance be made for the deviation, and which, in cases arising from excess of friction, will, upon a losing rate, necessarily be very considerably increased. This leads us to remark, that the variations in the rates of even Mr. Harrison's time-keeper previous to, and during its voyage to the Colonies and back again, in the years 1761 and 1762, afford much latitude for speculation on these points, though it certainly gave the longitude within the limits prescribed by the act. On this account alone, one would have supposed it would have elicited the favorable opinion of our late highly-gifted astronomer royal—yet it failed to do so. If the ship, however, returns from St. Antonio to Cape Clear, in the same period, and under similar circumstances, as to wind and weather, the watch will, notwithstanding, again agree with the time at Cape Clear, since its rate will be accelerated just as much on the passage home, as it was retarded going out.

3rdly.—If a time-keeper be so situated, as that that part of the balance possessing polarity shall coincide with a line drawn from its axis through its centre of oscillation, and with the direction of the ship's head, but is removed 90 deg. from the meridian, the watch will neither gain nor lose beyond its natural rate; because the local attraction acting in a right angular direction to that of the meridional attraction, they tend to neutralize each other, and hence the rate is not affected.

4thly.—But if no attention be paid to the polarity of the balance, when associating it with the other parts of the mechanism, or to the position of that balance after it has been so associated, two contiguous watches will evidently exhibit different results, and the various changes which the relative situation of the balance (in respect to meridional and local influence) will necessarily undergo from the ship's alteration in position, can never be detected; and consequently, as no reason can be assigned, why one portion of such a rate should be alone set down to one particular interposition in preference to another, so neither can any selection be made: the perfections and imperfections must therefore go together, and which, in the hands of inexperience, may not only involve the character of the watch undeservedly, but possibly, that of the mechanic.

Entertaining great veneration for the talents and perseverance of the late General Mudge, the beautiful symmetry of whose works (in such parts as this scientific officer was personally concerned,) stands, I may be permitted to observe, unimpeachable as well as unrivalled, united to an excessive, and I hope laudable, anxiety for the character of my own labors in the mouth of the British Channel, in which, not only our own shipping, but that of the whole world, are interested, and which are so intimately connected with those of the General, I am led more particularly to advert to the subject, having lately heard an opinion expressed unfavorable to the accuracy of the parallel circle, on which the longitudes of Dover, Beachy Head, Falmouth, &c., in the trigonometrical survey of Great Britain have been determined, and a question started as to the safety of determining the magnitude of the whole circle, from the construction of the spheroidal triangle there made use of, the foundation for which opinion seems built on chronometic results alone, unsupported by other agency, and even these results are stated to have been obtained afloat. Such an objection is, I consider, easily answered, for unless the deviation in the form of the earth from that of a true sphere can be proved to result from some other cause than that of central motion, the measure-

ment of the triangle, or any portion of the parallel there, must be sufficiently indicative of the magnitude and relative proportions of the whole periphery, since the contraction of the poles of the oblate spheroid, and the consequent dilation of the equatorial diameter, cannot in anywise operate upon the uniformity of the curvature in any particular parallel, however it may vary the radius; and secondly, that chronometrical results, when exposed to the vicissitudes of land or water-carriage, during all or any part of the interval to be measured, are not of a nature sufficiently conclusive to be placed in competition with geodetical measurement (unless provision is made for the contingencies before alluded to.) Still less, perhaps, can they be permitted to sanction any alterations in the meridians established by the trigonometrical survey of Great Britain; on the accuracy of which, indeed, the relative position of the Shamrock's soundings, and dangers in the British Channel and Atlantic particularly depend.

As, from what has been here advanced, it will no doubt be manifest, that the after-part of a ship's cabin (the common rendezvous of time-keepers in general) is not the most eligible position in which to anticipate spontaneous uniformity in the movements of a watch; because, in that very position, the worse consequences of friction are occasionally to be apprehended, especially in a small ship; so it is with the utmost deference, I venture to submit the expediency of placing time-keepers in general before the cabin bulkhead, in a place prepared amidships for the occasion, where friction is divested of one-third part, at least, of its effects; suspending them, on this occasion, after the manner of the marine barometer, which is decidedly better calculated to assuage the effects of rolling, pitching, and lurching at sea, than the present mode of hanging them in gimbals.

NIGHT TELEGRAPH.

An interesting and useful instrument under this name is now exhibited at that valuable institution, the Adelaide Gallery. It is the invention of Mr. Jennings, and intended to be used chiefly in ships, to give signals from one part of the vessel to another. For example, how often is it that amidst the roaring of the wind, and the lashing of the surge, it is impossible for the steersman to hear the voice of a man who may be looking out at the head of the vessel, or the men aloft hear the orders given them. Among a fleet, on a rocky shore, or amid sands and breakers, this is of the utmost consequence to the safety of all, and the want of some easily-managed machine has been long acknowledged.

The night telegraph of Mr. Jennings, consists of an upright iron rod, three or four feet high, which may be fixed to the deck, or to a moveable stand—near the top of this are two other iron rods, about four feet each, placed like the sails of a windmill, but capable of moving on their centres, so that they may be put in any required position. One end of one rod bears a lanthorn showing a blue light, one end of the other rod a red light, and at their union in the middle is a white one. This last lanthorn is a fixture, but the red and blue may be placed in eight different directions, each significant of some preconcerted sentence. These being understood, orders may be communicated rapidly and with certainty, under all circumstances of noise—of storm—or of battle. The machine may be easily and rapidly worked by a child; must, from its extreme simplicity, cost but a trifle; takes up scarcely more room than a musket; and weighs but a few pounds.

BIRD STUFFING.

(Resumed from page 6.)

Suppose a bird to be skinned as directed in a former paper, and it be desired to stuff it immediately, that is, while the skin is yet fresh, it may be proceeded with as follows:—

The first part to be attended to is the head. This is to be well anointed with the arsenical soap, or else washed with the solution of corrosive sublimate, (see page 8;) the skull stuffed with cotton, and the head drawn back into its proper place (supposing the skin to have been turned inside out, by the operation of skinning.) The whole of the inside of the skin is to be well rubbed with one of the above preservatives, and then the neck stuffed with tow evenly, but not too tightly. The legs may next, if not before, be cut off close to the body, and prepared for putting on again by getting a wire for each, long enough to reach from the skull through the body of the bird, and thighs and legs; and in addition, to project forward about two inches through the foot, ready to fasten the bird afterwards to the perch upon which it is to be fixed, which will be about nine inches long altogether, for small birds. The wires being cut off and sharply pointed at one end, make a hole with a fine bradawl up each leg, and thrust through these holes the two wires, beginning below at the ball of the foot. On that part which passes through the thighs, wrap some wool to the requisite size of this part of the bird, and draw the skin over the stuffed wire. These legs thus padded may be put aside. Next prepare a ball of hemp, or wool, of the shape and size of the body of the bird, and insert it within the skin, in its proper place. Before however this is done, it will be necessary to examine the wings, and to stuff them perhaps with a little wool around their thick ends, where the bones yet remain; but if the bird is not afterwards to be put in a flying posture, the stuffing of the wings is of little consequence.

The body having received the plug, or stuffing of hemp, is now to be sewn up; this need not be done by carefully sewing together the edges of the skin, but the needle may be carried through and through the body several times near the lower part, without regarding so minutely the exact orifice to be sewn up, being however very careful not to include in the stitches any of the feathers, as such would certainly spoil the round regular appearance of the body, and smoothness of the feathers, which it is so necessary to preserve.

The wires having the legs upon them are, after the sewing up of the body, to be inserted by their sharp ends into the holes from which the legs were cut, and thrust upwards through the tow with which the body and neck are lined, until they reach and come out at the front of the head, just over the beak, and pulled on until the legs are in the proper position close to the body.

Nothing is necessary beyond the above process in stuffing small cage birds; it is true they must be mounted, their wings and tails supported, and put on proper springs, &c., but this, which is the most difficult part of the whole operation, and requires both skill, observation, and a scientific knowledge

of the habits of individuals, we must treat of hereafter, and rather make a few remarks of other circumstances, and exceptions, relative to the skinning process.

In birds with long necks, such as the duck and swan tribe, a long wire must pass through the neck some distance along the body, and the tow used as the stuffing of this part wrapped around the wire carefully, previous to its insertion into its proper place. Also, supposing the bird is to be eventually in a flying, a fluttering, or any other position in which the wings are expanded, a wire must be passed up close to the bones of each of them, so as to meet and cross each other in the body, either running into the tow which fills it, or if placed there first they may be tied together to keep them firm.

In the stuffing of bird-skins which have been dried, such as the skins which come from abroad, they must previously be relaxed; this is a very simple process. First, take out all materials which may have been placed within the bodies, with a hooked wire or with forceps; then stuff the head and neck loosely with damp cotton, and also the orbits of the eyes, the mouth, &c. with the same, and wrap the bird in damp cloth, in which it is to remain twenty-four hours. It will now be found equally pliable and as easy to manage as a fresh skin, and in stuffing must be treated in the same manner.

(*Continued on page* 68.)

CARVING CAMEOS, FLOWER BROOCHES, MOTHER-OF-PEARL, &c.

Take the common helmet, or the red helmet shell, those whose inner surface is pink or dark colored are most suitable, cut them into squares with a lapidary's mill—round off the corners, and shape them into an oval on a wet grindstone. Fix the enamel side on a short stick with jeweller's cement—grind off the brittle surface, sketch the subject with a black-lead pencil (or it is better for a young artist to have a drawing of the size before him); cut the subject with engraver's tools, namely, a chisel tool to clear the bare places; a lozenge shape for forming the subject, and a scraper, made of a three-angled file, ground off taper to the point, for cleaning the enamel surface round the subject, and also for forming the lineaments and other delicate parts. The color on the cheeks and hair is produced by leaving the layer of colored shell on those places. The stick must be grasped in the left hand, and held firmly against a steady bench, and with the tool resting in the hollow of the right hand, dig away the shell. A convenient length for the tools is three inches and a half; they must be kept in good condition to work with care and truth. The cameos are polished with a cedar stick, or cork dipped in oil of vitrol and putty powder, and cleaned with soap and water. Mother-of-pearl is carved in the same way.

The waste pieces need not be thrown away, as the soft parts of them, and bits of ivory, are filed into shapes to form the corollas of those beautiful gold-mounted flower brooches so much in vogue, while the cheap gilt mounted ones are colored glass pressed into shape.

The univalve shells, before mentioned, are common ornaments in cabinets and on grotto works, and well known under their English name of helmet shells. The common one is called for its wide *lips*, cassis labiata, the other, cassis rufum. The genus cassis has a row of teeth on each side of its narrow mouth, and such large thickened lips, or turned-up portions, that often a considerable part of the shell consists of them. It is from this part that the best cameos are made. Inferior cameos are often made from an allied genus, the strombus or spider shell, but these are not of so fine a color. Both are found abundantly in the tropical seas.

HAIR PENCILS OR BRUSHES.

These are of many sorts, according to the purpose for which they are intended; the larger kinds, such as are used by house painters, have for their materials the coarser kinds of hair or bristles, such as those of the hog, &c. The finer sorts are more varied in their nature, and these are chiefly the particular objects of our present paper: they are made from the hair (particularly that which covers the tail) of various small animals, and although the more usual sorts are called *camel hair* pencils, yet the hair of the camel is not used at all; in fact, the camel is but scantily furnished with hair, and what there is, is but little adapted to the purpose proposed. The hair of many of the animals furnishing the furs of commerce answers extremely well. The *fitch* pencils are celebrated for their firmness, long-wearing properties, and as furnishing a fine point. The *black fitch* pencils only are produced from the fur so called; the *yellow fitch* pencils are formed chiefly from the tails of the English squirrel. The manufacture is as follows, for all the kinds, as given by Dr. Ure.

"We must wash the tails of the animals whose hairs are to be used, by scouring them in a solution of alum till they be quite free from grease, and then steeping them for 24 hours in luke-warm water. We next squeeze out the water by pressing them strongly from the root to the tip, in order to lay the hairs as smooth as possible. They are to be dried with pressure in linen cloths, combed in the longitudinal direction, with a very fine toothed comb, finally wrapped up in fine linen, and dried. When perfectly dry, the hairs are seized with pincers, cut across close to the skin, and arranged in separate heaps, according to their respective lengths.

"Each of these little heaps is placed separately, one after the other, in small tin pans with flat bottoms, with the tips of the hair upwards. On striking the bottom of the pan slightly upon a table, the hairs get arranged parallel to each other, and their delicate points rise more or less according to their lengths. The longer ones are to be picked out and made into so many separate parcels, whereby each parcel may be composed of equally long hairs. The perfection of the pencil depends upon this equality; the tapering point being produced simply by the attenuation of the tips.

"A pinch of one of these parcels is then taken, of a thickness corresponding to the intended size of the pencil: it is set in a little tin pan, with its tips undermost, and is shaken by striking the pan on the table as before. The root end of the hairs being tied by the fisherman's or seaman's knot, with a fine thread, it is taken out of the pan, and hooped with stronger thread or twine; the knots being drawn very tight by means of two little sticks. The distance from the tips at which these ligatures are placed, is of course relative to the nature of the hair, and the desired length of the pencil. The base of the pencil must be trimmed flat with a pair of scissors.

"Nothing now remains to be done but to mount the pencils in quill or tin-plate tubes, as above described. The quills are those of swans, geese, ducks, lapwings, pigeons, or larks, according to the size of the pencil. They are steeped during 24 hours in water, to swell and soften them, and to prevent the chance of their splitting when the hair brush is pressed into them. The brush of hair is introduced by its tips into the large end of the cut quill, having previously drawn them to a point with the lips, when it is pushed forwards with a wire of the same diameter, till it comes out at the other and narrower end of the quill."

MISCELLANIES.

Magic Mirrors.—The mirror with which distorted objects, such as that in our plate of No. 2, may be viewed, is either of polished steel, or else made of a phial, of the requisite diameter, and silvered within, in the same manner as is adopted for glass globes, &c.; that is, by an amalgam, formed by melting together half an ounce of bismuth and a quarter of an ounce each of grain tin and of lead; when melted, an ounce of mercury is to be added, and the whole being stirred together, is poured into the phial previously dry and warm. Turning this about slowly, the mixture will, when nearly cold, adhere to the glass, and a mirror be thus formed of the required form.—ED.

Winds most prevalent in Britain.—With regard to the prevailing winds of our native country, the following account is published in the "Transactions of the Royal Society." At London—

Winds.	Days.
South-west	112
North-east	58
North-west	50
West	53
South-east	32
East	26
South	18
North	16

The same register shows that the south-west wind blows more upon an average in each month of the year than any other, particularly in July and August; that the north-west prevails during January, March, April, May, and June, and is most unfrequent in February, July, September, and December, the north-west occurring more frequently from November to March, and less so in September and October, than in any other months. In the fifth volume of the *Statistical Account of Scotland*, there is a table of seven years' close observation, made by Dr. Meek, near Glasgow, the average of which is as follows:—

Winds.	Days.
South-west	174
North-west	40
North-east	104
South-east	47

In Ireland, the prevailing winds are the west and south-west.

ANSWERS TO QUERIES.

2.*—*What is British Gum?* A gummy substance, obtained by heating starch until it acquires a slightly-brown color, which it will do at a temperature of between 6 and 700 degrees. It is soluble in boiling water, but not in cold, and if a few drops of tincture of iodine be added to the solution when cold, a purple color is produced, and not in blue, which the unburnt starch would have produced—showing that during the roasting a chemical change has been effected. A gummy matter, analagous to this, is also obtained by the addition of strong sulphuric acid to woody fibre, as saw-dust or paper, and then saturating the acid with chalk, this gum is left.—INIOS.

3.—*What is Milk of Roses? English Milk of Roses.* Agitate together, until thoroughly mixed, one pint of rose water, one lb. of sub-carbonate of potass, and half-a-pint of olive oil.—TOPHAM.

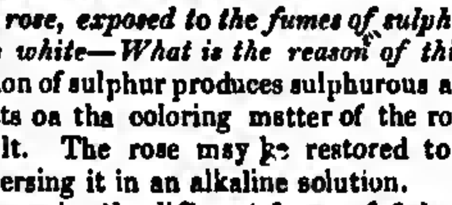
French Milk of Roses.—To the above add sixty drops of oil of lavender, and three of otto of roses, dissolved in a quarter of a pint of spirits of wine.—TOPHAM.

Cream of Roses.—Put over a gentle fire, in a well-glazed pipkin, one lb. of oil of sweet almonds, one oz. of spermaceti, and one oz. of white wax—when melted, add carefully one pint of rose water. Keep beating the compound till it becomes like pomatum, and then add two drams of Malta rose essence. Pour it into pots for use.—OOG.

Cold Cream.—Proceed as in the last receipt, except that instead of the rose water and essence, incorporate with the rest one ounce of orange-flower water and a little balm.—HOG.

5.—*A red rose, exposed to the fumes of sulphur, soon becomes white—What is the reason of this?* The combustion of sulphur produces sulphurous acid gas, which acts on the coloring matter of the rose, and removes it. The rose may be restored to its color by immersing it in an alkaline solution.

6.—*Whence arise the different forms of flakes of snow?* Whenever fluids are allowed to crystallize slowly, their molecules become so arranged that they invariably assume one form as their primitive—that is, each individual crystal will be of a similar form, though the whole mass may have any, according to circumstances: so it is with snow—at a certain height in the atmosphere the aqueous vapour coming into a colder region is frozen, but so slowly, that the molecules of water have time to arrange themselves, which they do in the most geometrical order. The primitive form of crystallized water is the rhombohedron, and when snow is examined by the microscope, though it assumes different forms, yet each will be a modification of the primitive, and we shall have small crystals arranging themselves in such a way that they look growing out of their fellows, at angles of 60°, forming hexahedral figures, such as



to an infinity of form, showing that though their figures are various, the same forces are in operation.

QUERIES.

20.—Is there in any museum a toad which has been imbedded in stone and also the stone which surrounded it? *Answered in page 56.*

21.—What is the reason that when a bell is casting if any one speaks it spoils the sound? [It is not a fact that it does.—ED.]

22.—Why does the fruit of a tree in grafting take after the scion, or upper piece, and not after the root? *Answered in page 52.*

* These figures refer to the number of the Query, as before published.

ERITH CHURCH, KENT.

FAC-SIMILE OF PHOTOGENIC DRAWING.

PHOTOGENIC DRAWING.

(Resumed from page 28.)

We have hitherto considered this art as applicable only to the delineation of flat and trivial objects, and as rather conducive to amusement than utility; but as paper acts not only by direct but reflected light, it may be made subservient to much more important uses, by the assistance of such lenses and mirrors as reflect the images given to natural objects upon a screen or medium. The chief instruments of this character are the camera obscura and the solar microscope. The former is applicable to take views of scenery, equally with small objects, and to diminish the view according to the desire of the operator, by removing the camera more or less distant from the object represented—or by using another camera with lens of a longer focus.

To take a Prospect, &c., on Photogenic Paper.—Point the portable camera (described at page 3) towards the required view or object, and place a piece of paper (prepared side downwards) upon the glass where the picture is seen, and immediately shut down the upper flap close upon it. In half-an-hour the color of the paper will be changed, in proportion to the strength of the light passing through the instrument upon it, and thus a delineation of surrounding objects be obtained, though, of course, the lights and shadows seen in the original will be reversed in the picture.

To take a Microscopic Object.—Place a piece of very sensitive paper, a short distance, (as eight or ten inches) from the object glass of a solar microscope; in a few minutes any object placed in the usual situation of the instrument will be depicted on the paper placed to receive it, and will be seen with infinitely greater exactitude than the most expert draughtsman can depict it. With the oxy-hydrogen microscope from ten to twenty minutes are necessary to produce the requisite effect.

To Fix the Drawings.—To do this with certainty is most difficult. Mr. Talbot says that to dip the drawings into a saturated solution of salt and water is sufficient to fix them, that is, to prevent change when the finished drawings should afterwards be subjected to light. This receipt may succeed occasionally, but it does not always, though certainly it retards, at all times, further discoloration.

Iodide of potassium, or, as it is more frequently called, hydriodate of potass, dissolved in water, and very much diluted, is a more useful preparation to wash the drawings with—it must be used very weak, or it will not only dissolve the unchanged muriate as is intended, but the blackened oxyde also, and the drawing be thereby spoiled.

The most certain material to be used is one of the hyposulphites, as proposed by Sir W. Herschell, who, very many years since, showed the peculiar effects of these salts in decomposing the nitrate, muriate, and carbonate of silver. Washing the photogenic drawing with a solution of hyposulphite of soda, no matter as to the strength of the solution, the muriate which lies upon the lighter parts of it will become altered so much in their nature as to become unalterable to light, while the rest remains dark as before.

Before using either of these preparations for fixing the drawings, they should be soaked for a minute or two in hot water, which, of itself, removes a large portion of the muriate of silver that is to be got rid of.

Suppose the drawings, when taken, are to be seen only by candlelight, or are required only to put in a portfolio, that they may be sent to a distant place, no preserving preparation will be necessary; thus travellers need not trouble themselves to wash their pictures, till at a future time when they may have greater leisure.

Application.—Mr. Talbot has recorded so many applications of his process that little can be added to his list. The first advantage which he alludes to is taking of portraits or silhouettes, by means of the shadow thrown upon the paper by the living face. Second—the copyings of paintings on glass by the light thrown through them on the prepared paper. It may be remarked that the effect in this case is very singular, as may be tried with a magic lanthorn slider, for, as some of the colors intercept the violet rays of light, the effect produced is often contrary to that expected; for example, if a part of the glass be yellow, as this is the lightest color, we might suppose the paper beneath would become very dark, but in truth the paper beneath will scarcely be changed at all, for the yellow glass will intercept all the violet rays. Thirdly—another imitation is that of etchings; this was suggested by Mr. Havell, and since claimed also by Mr. Talbot. This is done by painting a piece of glass with a thick coat of white oil paint; when dry, with the point of a needle, lines or scratches are to be made through the white lead ground, so as to lay the glass bare, this being done, place the glass upon a piece of the paper, and, of course, every line will be represented beneath of a black color, and thus an imitation etching will be produced. This has been thought by some a valuable discovery, how can it be so, when, with precisely the same skill and labour, a real etching on copper or steel can be prepared, and may be printed afterwards infinitely cheaper than the mere cost of photogenic paper.—Fourthly—microscopic objects, and here the art is indeed valuable; Mr. Talbot truly says, "The objects which the microscope unfolds to our view, curious and wonderful as they are, are often singularly complicated. The eye indeed may comprehend the whole which is presented to it in the field of view, but the powers of the pencil fail to express these minutiæ of nature in their innumerable details. What artist could have skill or patience enough to copy them? Or, granting that he could do so, must it not be at the expense of much most valuable time, which might be most usefully employed?" Fifthly—the delineation of architecture, sculpture, landscapes, and external nature. Sixthly—the copying of engravings, and the tracing of various flat objects, such as the plants in an herbarium, pattern of various tissues and fabrics, and many other things incidentally alluded to in these papers; and taking into account the discovery of Mr. Francis (whose plates adorn our present number) of forming these various objects at once upon box wood, as described in our last, we cannot but conclude that notwithstanding the uncertainty there exists in the effect of the process, the dimness of the copies, and the difficulty of fixing properly what has been obtained, that in a short period, this art, uncertain as it at present is, and as all infant arts must be, will soon arrive at a degree of certainty and perfection, which will render it of the utmost consequence to the artist, the traveller, and the naturalist; more especially as all the philosophers and chemists of our own country, of France, and of Germany, have their attention so forcibly drawn to

the subject, in hopes of explaining the still more important discoveries of M. Daguerre, who produces pictures in their proper lights and shadows, and the valuable process of M. Naipce, who could, even many years ago, impress them at once upon a copper plate, engraving them there, in all their beauty, and with scarcely any expenditure of either money, time, or talents.

It may be advisable to add to this part of the subject some remarks upon it by Dr. Fyfe read before the Edinburgh Society of Arts, in March and April of the present year. He says:—

"I may here allude to a valuable practical application of photography, in diminishing the labours of the lithographer. In communicating the impression of any object to the stone, as of a dried plant, or in copying an engraving, it is necessary to trace them on paper, and, after again tracing them with the transfer ink, to transfer them to the stone. Now, by receiving the impression on paper by the photographic process, all the labor of the first tracing is avoided. But there is no necessity for using paper, as the impression may at once be communicated to the stone, which easily receives the phosphate, and which may, therefore, be prepared in the same way as the papers, and the impression also taken in the usual manner, after which it is traced over with the transfer ink. By this process, not only is a great deal of labor saved, but the representation must be much more exact than when traced; for though, by the latter, the outline is correct, yet much is left to be afterwards filled in by the eye, whereas, by the photographic process, every, even the most minute filament, is distinctly and accurately laid down on the stone.

"*Method of taking Impressions in which the lights and shades are not reversed.*—By the different methods now described for getting photographic impressions, the lights and shades are always reversed, because, as it is by the action of the light that the compound of silver is darkened, wherever it is prevented from penetrating, the paper retains its original color. Though the impressions thus procured are accurate as to outlines, yet, in many cases the representation is far from being pleasing; it is, therefore, a great desideratum to have a method of getting impressions in which there is no reverse; in fact, to give a true representation of the object, and in this I have succeeded by the use of the iodide of potassium. When the darkened phosphate of silver* is exposed to the iodide, it is instantly converted to yellow, provided the solution is of sufficient strength; if weak, the action goes on slowly. In some impressions which I had attempted to preserve in this way, I observed, that, when exposed to light, they began to fade, which induced me to try the effect of light on darkened paper, soaked in solution of iodide, of such strength, that it just failed to attack it instantly. In my first attempt I succeeded in bleaching the paper, but in my next I failed. On considering the circumstances under which these trials were made, I found that the only difference between them was, that in the first the paper was moist, in the last it was dry. Accordingly, on repeating the experiment with the paper moist, I again succeeded in getting a delineation of the object placed on the paper, as distinct, and altogether as brilliant as those obtained by the other process.

"The method which I now follow is, after preparing the phosphate paper, to darken it, then immerse it in solution of iodide of potassium, of such strength that it does not act instantaneously, and, *when still moist*, to expose it to light with the object on it, and continue the exposure till the exposed part of the paper becomes yellow. In this case, there is a tendency in the iodide to convert the dark phosphate to yellow iodide, which would go on slowly, but is hastened by the light; of course, if the object on the paper is impervious to light, the impression is black throughout, but if it is of different density, so as to allow the light to be differently transmitted, the impression presents the lights and shades as in the object itself; because those places behind the dense pieces retain their original blackness, while those behind the less dense are more or less bleached, just according to the transmission of the light. When impressions, thus procured, are kept, they begin to fade, owing to the slow but continued action of the iodide of potassium; hence the necessity of a preservative process. After repeated trials, I have found that by far the simplest and the best is merely immersion in water, so as to carry off the whole of the iodide of potassium not acted on by the phosphate, and by which any farther action is completely prevented. By this method, the specimens do not lose in the least their original beauty, and they may be exposed to continued sunshine without undergoing the slightest alteration.

"I have succeeded also in taking impressions with the chloride in the same way—but it is necessary, for the success of the process, to use the solution of the iodide much weaker than for the phosphate, because the chloride is more easily acted on. In both cases it ought to be made of such strength that it just acts, and then, before using it, it must be weakened by the addition of a little water. For the phosphate, it will be found, in general, that 1 of salt to 10 of water, and for the chloride, that about 30 of water, will give a solution of the requisite strength. Of course, in preserving the specimens, the precautions as to washing and pressure must be attended to."

(Continued on page 59.)

MAGIC LANTHORN AND PHANTASMAGORIA.

(Resumed from page 18.)

Screens and Media.—For receiving the images cast by the common magic lanthorn, which are viewed on the side of the medium upon which they are cast, little difficulty can be found, it being only required white and smooth. Thus a clean-washed sheet, stretched tightly upon a wall answers the purpose well, or could a room be devoted to the purpose of exhibition, as at public institutions, the whitened wall itself is an appropriate object screen, whether painted in water or turpentine (oil is improper as it produces a glossy surface). This kind of screen is best adapted to exhibit the solar, lunar, and oxy-hydrogen microscope, and is that employed for the purpose.

For the use of the Phantasmagorial Lanthorn a transparent screen is necessary, because it is placed between the spectator and the lanthorn, the objects being thrown upon one side of the screen and seen

* Dr. Fyfe uses the phosphate of silver as preferable to the muriate or nitrate.

through it on the other. It is, therefore, to be so far transparent as to permit the colors and form of the objects to be seen perfectly and distinctly, yet not so much as to show the brilliant spot of light which the lens of the lanthorn casts. In other words, it should be of such a nature that if you look at a candle through it, you may see a diffused light but not the flame itself. There is but one common substance which will fulfil this condition, and this is tissue paper in its usual state. Some persons have advised to oil the paper, but it then becomes too transparent. Others have recommended muslin wetted, and indeed it makes a tolerably good medium, but by no means equal to the tissue paper, though its greater strength of texture renders it available in circumstances where paper would be inconvenient. Mr. Childe uses waxed muslin when exhibiting his "*Dissolving Views*" at the theatres, but the astronomical lecturers commonly employ paper in preference.

Another sort of medium was once used, and to the effect of which we are indebted for the phantasmagoria itself. This instrument was used in the first instance rather to inspire terror than to excite mirth, and the principal upon which it acts is but a modification of the ancient method of using the magic lanthorn, which also once was an apparatus used for the worst purposes of superstition and trickery. Its images were usually thrown upon *smoke* rising from a chafing dish, and when the image was terrific, the apartment cold and gloomy, the air redolent with essences, and the mind of the spectator previously prepared to witness a miracle, we cannot be surprised that such an exhibition worked intensely upon the imagination, and that the magic lanthorn was a powerful instrument in the hands of the crafty and the designing.

Painting the Sliders.—Few instructions can be given upon this part of the subject beyond the mere naming of materials; these are few and easily procured. The brushes to be used are common hair pencils, which may be cleaned from time to time with turpentine. All the colors must be transparent, carmine and lake, Prussian blue, Indian yellow, burnt sienna, burnt umber, and verdigris, are the colors most employed for the pictures.—They are ground in oil, as sold in bladders by the artists' colormen, and mixed before using with mastic varnish, which dries quickly and is colorless; white is produced by leaving certain parts of the figure entirely without color, that the light may have no impediment in passing through. The half colors are produced by a proper mixture of red, blue, and yellow; thus purple, by uniting blue and red, orange, by red and yellow, &c. The shadows may be managed by a stronger tint of the proper color, or else by brown or blue, according to the effect required. The outlines of the figures also may be made first by a fine camel-hair pencil, dipped in black color. In painting slides, the chief rule to be observed, is, to allow properly for the change of color produced by the light itself, which has a tendency to cast a yellowish tint upon every part, and thus, paintings that appear in proper colors by daylight, will often fail when illuminated by candles or a lamp; the color of the sky, therefore, must be painted of a moderately *dark* blue, the trees, grass, &c., of a bluish green, the reds, never shaded with blue, and purple used very sparingly; for the *blue* and *red*, which produces this color, being united to the *yellow* light, form the mixture called *neutral tint*, a color that is dull and heavy for this purpose. The use, also, of opaque colors, even in producing shadows or tints, is carefully avoided, thus, white lead must never be used, either alone, or in combination. It is sometimes desirable to remove a part that has been painted, after it has become dry, this may be easily done by a penknife point, and in those slides which show clear lines on a dark ground, as in astronomical diagrams, the effect is produced by painting the whole black, suffering it to dry thoroughly, and then scratching the lines through the black ground with a needle or other point; should the lines, thus made, be desired of any certain color, it is only requisite to paint them with the proper tint, after being scratched through.

It is obvious that no rules can possibly be given to teach the artistical part of painting; a knowledge of effect—of perspective—of figure drawing—and of the manipulation of blending, and laying on the colors. It must depend upon the previous skill of the painter, but with an ordinary knowledge of the fundamental rules of art, success will attend his efforts, especially if he constantly keep in remembrance the effect of artificial light as before observed, that intense colors do not appear too glaring when the objects are magnified on the screen, but that any defect of form, or error of drawing or perspective becomes proportionably magnified.—The subject of moveable sliders is too varied to admit of explanation hastily, we shall, therefore, devote a paper another time to them.

(*Continued on page 223.*)

METEOROLOGY.

ANCIENT HISTORY OF THE SCIENCE.

By the Senior Secretary to the Meteorological Society.

THE early history of meteorology is involved in much obscurity and uncertainty. The first cultivators of this important science did not arrive at the true cause of those interesting phenomena to which they were eye-witnesses; consequently they made but little progress, partly from their ignorance of astronomy, and partly from the want of instruments necessary to make observations. Among the most ancient promoters of the study of meteorology, we find Theophrastus, a celebrated botanist and physician, who collected all the popular prognostics of the changes of the weather that were current in his day; to which he prefixed the most ancient ones that are to be found in the Bible: the whole of which Aratus put into Greek hexameter verse in his "Diasems." These Virgil expressed in the most elegant language in his "Georgics." Lucretius copied many of them into his celebrated book, "De Rerum Natura." Aristotle, Plautus, Seneca, and Lucan, also, accurately took notice of, and recorded atmospheric phenomena. Thus we find both Greeks and Romans handing down these popular opinions. More modern philosophers have written commentations on all these authors, and expatiated largely upon them in copious notes, and varied illustrations. Still meteorology made no progress as a science. The object of their observations was to enable them to predict, with greater certainty, the future changes of the weather; indeed this is the most useful purpose to which meteorology can be applied; but we do not possess, even at the present time, sufficient data to do this with any degree of certainty. Shepherds, husbandmen, mariners, and others, whose employment kept them almost constantly in the open air, and

who had made themselves familiar with the most popular prognostications of the ancient philosophers just referred to, could foretel with greater certainty what sort of weather was coming, than their most scientific philosophers and meteorologists: hence they formed a sort of intermediate code of prognosticating rules, founded partly on the ancient traditions, and partly on experience. We find, too, numerous little sayings, proverbial adages, and quaint expressions respecting the weather, which have been handed down from the remotest antiquity; but many of which, from a departure from the ancient writers, and from repeated introductions of new adages, after a lapse of a few centuries, lost their force and dwindled into mere absurdities.

The ancient writers, the authors, or collectors of those adages which had reference to the changes of the weather, founded their prognostics upon their imperfect notions of astronomy. The periods of the heavenly bodies were made use of to measure the parts of the year, and their regular returns were accurately compared with the periodical returns of terrestrial phenomena, and used to designate the year, the months, the days, the hours, and the seasons. Ephemerides, calendars, and almanacs, of all kinds, began to be constructed for the purpose of determining the several seasons of the occupation of the husbandman in each; hence we find, in all the ancient works, on this subject, numerous astronomical allusions, and references to the great antiquity of the constellations, all of which bear testimony to the importance attached to this science, if at that time it could be justly so termed by our forefathers. Their agricultural occupations were regulated by the rising and setting of the constellations of the zodiac, and others, that were very conspicuous in the heavenly vault; they then compared these daily phenomena with the arrival of birds, the flowering of plants, and other natural phenomena, and thus laid the foundation of the ancient rustic calendars. Virgil alludes in the commencement of, and indeed throughout his "Georgics," to the celestial signs of the seasons. He says:—

—"quo sidere terram
Vertere, Mæcenas, ulmisque adjungere vites conveniet."
"Under what star we may prepare the ground,
And when to elms the grape vines may be bound."

And to the sailor he says:—

"Navita tum stellis, numeros et nomina fecit,
Pleiades, Hyades, claramque Lycaonis Arcton."
"The sailors quartered heaven, and found a name
For every fixed and every wandering star,
The Pleiads, Hyads, and the Northern Car."—*Dryden.*

These observations must have been a source of amusement and advantage, both to the shepherds, the husbandmen, and the mariners of old; who, being constantly exposed to the heavens, in a fine climate, and beneath an almost perpetually serene sky, had innumerable opportunities of watching the various changes of the length of the days, the progress of the seasons, and the atmospheric phenomena connected with them. The science of the celestial signs is ascribed by Cicero to the Assyrians and the Babylonians. Other writers ascribe it to the Indians and the Egyptians. Of this, however, we are not satisfactorily informed, but we have seen that it was earnestly cultivated both in Greece and Rome, at a very early period. Steering vessels by the stars is among the earliest recorded facts in the history of navigation; so is the planting, sowing, and gathering-in the fruits of the earth by the stars, among the earliest records of agriculture. The ancient mariner had his fixed index of the Northern Pole—the "Tyrian Cynosure:" he watched for the "rainy Hyades, the stormy Orion, and the signum pluviale capellæ." He knew by the rising of the "Pleiades," when the seas would be open for sailing; he guarded against the coming storm by the setting of the "Arcturus," and the rising of the "Hoedi." He knew the hour of the day by the altitude of the sun, and he kept the watches of the night by looking well to the position of "Ursa Major." The husbandman, too, marked the different seasons by the overflowing of the Nile; for "Sirius, or the Dog Star," admonished him of its approach: by the setting of "Pisces," and the return of the swallow, he marked his season of spring. In short, every rustic occupation had its admonitory sign, and the husbandman regulated his labors for every month in the year by the signs of the zodiac. The shepherd was equally dependent on the movements of the heavenly bodies. He had his "Pascal," "Aries," and his star of "Arcady." He unfolded his flock with the morning ray of "Phosphorus," and watched at eventide for the "star that bids the shepherd fold."

FOSSIL INFUSORIA.

(Extracted from the Yearly Address of the President of the Geological Society.)

"The council have adjudged the Wollaston medal for the present year to Professor Ehrenberg, for his discoveries respecting fossil infusoria and other microscopic objects contained in the materials of the earth's strata. We all recollect the astonishment with which, nearly three years ago, we received the assertion, that large masses of rock, and even whole strata, were composed of the remains of microscopic animals. This assertion, made at that time by Professor Ehrenberg, has now not only been fully confirmed and very greatly extended by him, but it has assumed the character of one of the most important and striking geological truths which have been brought to light in our time: for the connection of the present state of the earth with its condition at former periods of its history, a problem, now always present to the mind of the philosophical geologist, receives new and unexpected illustration from these researches. Of about eighty species of fossil infusoria which have been discovered in various strata, almost the half are species which still exist in the waters; and thus these forms of life, so long overlooked as invisible specks of brute matter, have a constancy and durability through the revolutions of the earth's surface which is denied to animals of a more conspicuous size and organization. Again, we are so accustomed to receive new confirmations of our well-established geological doctrines, that the occurrence of such an event produces in us little surprise; but if this were not so, we could not avoid being struck with one feature of Professor Ehrenberg's discoveries;—that while the microscopic contents of the more recent strata are all fresh-water infusoria, those of the chalk are bodies, *(Peridineum, Xanthidium, Fucoides,)* which must, or at least can, live in the waters of the ocean. Nor has Professor Ehrenberg been content with examining the rocks in which these objects occur. During the last two years he has been pursuing a highly interesting series of researches with the view of ascertaining in what manner these vast masses of minute animals can have been accumulated. And the result of his inquiries is, that these creatures exist at

present in such abundance, under favorable circumstances, that the difficulty disappears. In the Public Garden at Berlin he found that workmen were employed for several days in removing in wheelbarrows masses of fossil infusoria. He produced from the living animals, in masses so large as to be expressed in pounds, tripoli, and polishing slate, similar to the rocks from which he had originally obtained the remains of such animals; and he declares that a small rise in the price of tripoli would make it worth while to manufacture it from the living animals as an article of commerce. These results are only curious; but his speculations, founded upon these and similar facts, with respect to the formation of such rocks, for example, polishing slate, the siliceous paste, called *kieselguhr*, and the layers of flint in chalk, are replete with geological instruction.

"As the discoveries of Professor Ehrenberg are thus full of interest for the geological speculator, so have they been the result, not of any fortunate chance, but of great attainments, knowledge, and labor. The author of them had made that most obscure and difficult portion of natural history, the infusorial animals, his study for many years; had travelled to the shores of the Mediterranean and the Red Sea in order to observe them; and had published a work far eclipsing anything which had previously appeared upon the subject. It was in consequence of his being thus prepared, that when his attention was called to the subject of fossil infusoria, (which was done in June, 1836, by M. Fischer,) he was able to produce not loose analogies and insecure conjectures, but a clear determination of many species, many of them already familiar to him, though hardly ever seen perhaps by any other eye. The animals, (for he has proved them to be animals, and not, as others had deemed them, plants) consist, in the greater number of examples, of a staff-like siliceous case, with a number of transverse markings; and these cases appear in many instances to make up vast masses by mere accumulation without any change. Whole rocks are composed of these minute cuirasses of crystal heaped together. Professor Ehrenberg himself has examined the microscopic products of fifteen localities, and is still employed in extending his researches; and we already see researches of the same kind undertaken by others, to such an extent, as to show us that this new path of investigation will exercise a powerful influence upon the pursuits of geologists.

"It may be further added, that even since the council adjudged this medal, Professor Ehrenberg has announced to the Royal Academy of Sciences, of Berlin, new discoveries; particularly his observations on the organic structure of chalk; on the fresh-water infusoria found near Newcastle and Edinburgh, and on the marine animalcules observed near Dublin and Gravesend; and, what cannot but give rise to curious reflection, an account of *meteoric vapor* which fell from the sky, in Courland, in 1686, and was found to be composed of confervæ and infusoria."*

* Converva are thread-like flowerless plants. Infusoria are minute animalculæ, such as are found in solutions.—Ed.

REVIEW.

Natural Philosophy. (Laws of Matter and Motion,) by W. & R. Chambers, Edinburgh.

The little treatises now publishing under the title of "Chambers's Educational Course," promise to effect an important revolution in the school education of the country; they are not however mere dogmatical school books, nor yet are they only applicable to the young, but may rather be considered well digested hand books of literature and science, useful as a reference, and as a guide to all persons, giving in plain language the most valuable truths. Several subjects have been already published on history, natural philosophy, &c.; with the latter subjects only we have now to do, and have chosen to justify and illustrate our opinion by that on the "Laws of Matter and Motion," for it is upon these that all the arrangements of material substances, causes of phenomena, and working of nature's changes depend.

The authors have in this little treatise considered matter in all its properties, relations, and varieties; its laws while at rest, and when in motion; in its various attractions and its repulsions; the gravity of some kinds, the imponderable nature of others; on action and re-action; the composition and resolution of forces. Thus the whole together contains the more valuable elements of the mechanical and the chemical sciences explained briefly, and yet fully; clearly, and yet scientifically. The following is on the destruction of matter:—

"Particles of matter are never destroyed or lost, although they may disappear from our immediate observation. Under certain circumstances the particles may be again collected into a body without change of form. Mercury, water, and many other substances, may be converted into vapor, or distilled into close vessels, without any of their particles being lost. In such cases, there is no decomposition of the substances, but only a change of form by the heat; and hence the mercury and water assume their original state again on cooling.

"When bodies suffer decomposition or decay, their elementary particles, in like manner, are neither destroyed nor lost, but only enter into new arrangements, or combinations with other bodies. When a piece of wood is heated in a close vessel, such as a retort, we obtain water, an acid, several kinds of gas, and there remains a black, porous substance, called charcoal. The wood is thus decomposed or destroyed, and its particles take a new arrangement, and assume new forms; but that nothing is lost, is proved by the fact, that if the water, acid, gases, and charcoal, be collected and weighed, they will be found exactly as heavy as the wood was, before distillation. In the same manner, the substance of the coal burnt in our fires is not annihilated; it is only dispersed in the form of smoke, or particles of culm, gas, and ashes or dust. Bones, flesh, or any animal substance, may in the manner be made to assume new forms, without losing a particle of the matter which they originally contained. The decay of animal or vegetable bodies in the open air, or in the open ground, is only a process by which the particles of which they were composed, change their places, and assume new forms.

"The decay and decomposition of animals and vegetables beneath the surface of the earth, fertilise the soil, which nourishes the growth of plants and other vegetables; and these, in their turn, form the nutriment of animals. Thus is there a perpetual change from death to life, and as constant a succession in the forms and places which the particles of matter assume. Nothing is lost, and not a particle of matter is struck out

of existence. The same matter of which every living animal and every vegetable was formed in the earliest ages is still in existence. As nothing is annihilated, so it is probable that nothing has been added, and that we ourselves are composed of particles of matter as old as the creation. In time, we must in our turn suffer decomposition, as all forms have gone before us, and thus resign the matter of which we are decomposed to form new existences."

PAPER-MAKING FROM BOG-PEAT.

At the meeting of the British Association, in the year 1835, Mr. Mallet enumerated the following experiments to obtain a cheap and yet good substitute for hemp rags, for affording a pulp fit for paper-making, which has long been a desideratum with the manufacturer. Many attempts have been made to procure one, but the difficulties of finding one such as would suit the required conditions, and the duty and cost of the hemp-rags, have induced adulteration to a vast extent in the paper manufacture. Much of the letter-paper now in use owes its apparent thickness, and stiff, close texture, to an intimate admixture of the pulp or vegetable fibres with a cream of plaster of Paris or whiting. Brown paper is adulterated with ground clay, and, for similar purposes, currier's shavings, chopped wool and hair cotton-flyings, thistle-down, and other similar materials, have been occasionally tried: but from none of them has good paper ever been made; and amongst the many experiments that have been attempted with them, being the only one that has been brought into successful use, is that of the manufacture of paper from straw, which answers tolerably for some purposes, though not for writing on, and is now made in some few places very extensively.

Under these circumstances, it appeared probable that nature might afford some vegetable fibres, of a texture sufficiently fine for making paper, and which had never undergone any manufacturing process; and on looking around, the *confervæ* of fresh-waters, and also certain varieties of turfs or peats, suggested themselves. The former was soon found too fragile, and its structure unfit to resist the action of the bleaching re-agents.

It is generally known that a peat-bog, and especially those of Ireland, consists of various strata, varying in density and other properties in proportion to their depth. The top surface of the bog is usually covered with living plants, chiefly mosses, heaths, and certain aquatic or paludose plants; immediately beneath this lies a stratum varying from only two or three inches to four or five feet, according to the state of drainage of the bog, of a spongy, reddish-brown, fibrous substance, consisting of the remains of vegetables, similar usually to those living on its surface, in the first stage of decomposition.

The chemical state of this stratum is nearly that of some of the papyri found in moist places in Herculaneum; that is to say, having long been exposed to the action of water, at nearly a mean temperature, the vegetable juices have nearly all been converted into ulmin-geine, or impure extractive matter, and the fibres remain nearly untouched, together, probably, with some of the essential oils of the original plants. It, therefore, seemed that, if these fibres, which were apparently sufficiently fine for the purpose, could be separated from their coloring matters, the object would be nearly, if not entirely attained; to this, therefore, attention was directed, and was attended with success. It is unnecessary here to enter into any detail of experiments, or into any elaborate disquisition as to the principles concerned, in making a white pulp from this material, either as regards the manufacturer or the pure chemist; presuming these to be already understood, the process may be briefly stated as follows:—

The proper description of turf being selected, is soaked in cold water until all its parts are softened, and, to a certain extent, disintegrated; it is then bruised in a suitable engine, in cold water, which is continually agitated and renewed, so that all pulverulent matter (or saw dust while the turf is dry), may be washed off. The so far cleansed fibres are then partially dried by strong pressure, in hair bags, under the hydraulic press, or by other suitable means, and then by suitable sieves and winnowing; all roots, sticks, or other gross matter incapable of being bleached, are removed. The fine, uniform, brown fibres, or rather minute stems, leaves, &c. &c., are then placed in proper vats, and digested in the cold; that is, at ordinary temperatures, with a very dilute solution of caustic, potass, or soda; preferring that made from what is called, in commerce, "black potash."

After some time, nearly the whole of the geine and other extractive matter is removed, in combination with the alkali. The fibres are again pressed dry, or nearly so, from the digesting liquor, and are now found to be of a dark fawn color, in place of their former deep red brown. They are next transferred into an exceedingly dilute sulphuric acid, containing not more than fifty grains of acid of commerce to the quart of water. They remain in this at the common temperature for some time, generally about four hours, but varying with the kind of turf; this separates the iron and earthy matters from the fibre, and carries off the adhering portions of potass and of ammonia, if any exist in the turf, which is occasionally the case. The fibres are now washed with pure cold water, until they cease to give any acid re-action, and are finally pressed nearly dry, and immersed in a dilute solution of chloride of lime; in this they remain at common temperature until sufficiently white for the purpose of the paper-maker, and, on being removed, will generally be found fine enough, as to fibre, for immediate manufacture; but, if not, are to be reduced by the ordinary rag-engine, or other suitable machinery.

By this process it is calculated that about eighteen pounds weight of pure white, fine pulp, may be procured from 100 weight of the raw or the native turf.

Returning now to the solution of the potass, which has carried off the geine, &c., and which is chiefly, in fact, a geiuate of potass; it is treated with dilute sulphuric acid, slightly in excess, and filtered through a calico or linen cloth. The potass is taken up by the acid, and the geine and extractive matter precipitate, and are collected on the filter, from which, being removed, they are dried by a steam or water-bath, and become a valuable pigment.

Vandyke brown has long been known to painters in both oil and water colors. This is it, in fact, in its purest form; it is an extremely rich, glowing color, and valuable for its permanence, as scarcely any agent ordinarily met with is capable of affecting it.

When once perfectly dried, it becomes insoluble in water, and, therefore, is not in the least deliquescent, but it is still soluble in alkalies; thus possessing two properties eminently fitting it for the uses of the paper-stainer and scene-painter, &c. &c. It is perfectly miscible with gum, mucilages, and with oils.

The liquid from which this color or bistre has been separated now contains various sulphates in solution, chiefly of iron, lime, and alumina; but the major part, sulphate of potass, or soda, whichever has been employed; if the former, Glauber's salt may be made from it, and if the latter, alum, as matters of commerce. The quantity of alkali used is small in proportion to the amount of fluid; but if the operations were very extensive, this economical use of them should be attended to.

After the fibre has been some time digested in the solution of chloride of lime, in most cases a resinous-looking matter floats upon the surface of the fluid in a very minute quantity. This, when a large quantity is operated on, may, by careful management, be collected, and is found to be a species of artificial camphor, mixed with some gum resin, and probably an essential oil. This substance, or mixture of substances, possesses some singular characters: it would seem probable that the artificial camphor is produced by the action of some fine chlorine upon turpentine, existing in minute quantity in the turf; and it is a curious subject for reflection, that chemistry should thus, as it were, recall into existence and decompose the turpentine existing in, and produced by trees or plants which have, for hundreds of years, ceased to have life, or to exist as vegetables. As the properties, so far as they have been ascertained, of this singular substance are purely chemical, it is unnecessary here to detail them. It is not to be procured from every specimen of red or surface turf.

Some specimens of turf have been met with, unfit, however, for paper-making, from which it would appear to be profitable to manufacture bistre and ammonia, from the very appreciable quantity of the latter they contain.

This fibrous red surface turf, when dry, is extremely tough, and is proposed being also applied as a substitute for mill-boards, or board-paper, for the use of engineers, &c. It is capable, when dry, of immense compression by the hydraulic press;—and as the fibres naturally lie nearly all in one plane, they thus arrange themselves, so as to give great toughness and flexibility to a plate of it when compressed. Accordingly, suitable masses of this turf are placed in a strong cast-iron, or other vessel, and the air exhausted; the vessel is then filled with a mixture of dilute solution of glue and molasses, at a boiling heat, which fills all the pores of the turf. The masses are then removed, while hot, and exposed to powerful pressure in a hot-press, in a similar way to hot-pressing paper, which reduces them to the required thickness, that of the original mass having been previously properly regulated. The plates so formed are found, when cold, to be hard, tough, and flexible, and will answer almost every purpose of mill-board. They are not injured by high-pressure steam. Many other substances may be used, according to circumstances, for filling the pores, previous to pressure—as fat, oils, boiling coal-tar, wax, &c. &c.

It is worthy of remark, that the substance proposed being used for all the above processes, is the worst turf for burning; so that the material which is worst, and nearly valueless as fuel, is the best and most valuable, by a fortunate coincidence, for manufacturers. If, therefore, as there is reason to believe, the lower strata of turf can, by certain modes of charring, be made a valuable fuel, and the upper and more recent strata are used for the purposes of the various manufactures above adverted to, there is strong ground of hope that, at a future period, the bogs of Ireland, instead of being contemplated, as hitherto, as a blot and stain upon her fair and fertile champaign, may be looked upon as one of the centres of her industry, and the richest sources of her wealth.

We examined specimens of the pulp, described as being yielded from peat, at the rate of eighteen per cent. and have no hesitation in saying that it appeared to be white, pure, and perfectly suited to the manufacture of paper.

With respect to the bistre color, we were assured, by a very competent judge, that he considered it quite eligible for the use of the artist, the house-painter, and the paper-stainer. He also spoke favorably of the mill-boards, formed by the operation described; and had no doubt but that the other products from the combinations employed, such as alum, Glauber's salt, artificial camphor and ammonia, would fully answer the purposes of commerce.

Ireland, we believe, is *blessed* with two millions of acres of bog (of which 1,300,000 are susceptible of drainage and cultivation*); and if it should be convertible into so many useful articles of consumption, how prodigious must be the sources of employment and improvement which it will open to the view of the statesman and philanthropist.

* According to Parliamentary returns: the greatest depth forty-five feet; and the average depth twenty-eight feet.

QUERIES.

23—Animal heat, whence is the origin of it? *Answered on page* 75.

24—How may shells be best cleaned? *See page* 95.

25—How are fossil woods cut and ground, so as to be fit microscopic objects? *Answered on page* 56

26—Where can fossil animalcules be purchased? *Of Mr. Pritchett, in Fleet Street.*

27—Why does a fine needle float upon water? *Answered on page* 56.

28—Why does the wick of a floating chamber-lamp always go to the side of the vessel of oil in which it is burning? *Answered on page* 56.

29—How are the fantoccini figures made and managed? *Answered on page* 311.

30—How is the canvass, used by oil painters, prepared? *Answered on page* 128.

31—How are the leads for ever-pointed pencils made? *Answered on page* 128.

32—Why does rotten wood give light in the dark? *See page* 72.

33—What occasions the singing (as it is called) of a tea kettle before boiling? *Answered on page* 72.

34—What occasions the rumbling noise we hear when hot iron is plunged into water, or steam let into a cold vessel? *Answered on page* 72.

35—In one of Mr. Childe's dissolving views snow appears to fall—how is it managed? *Answered on page* 271.

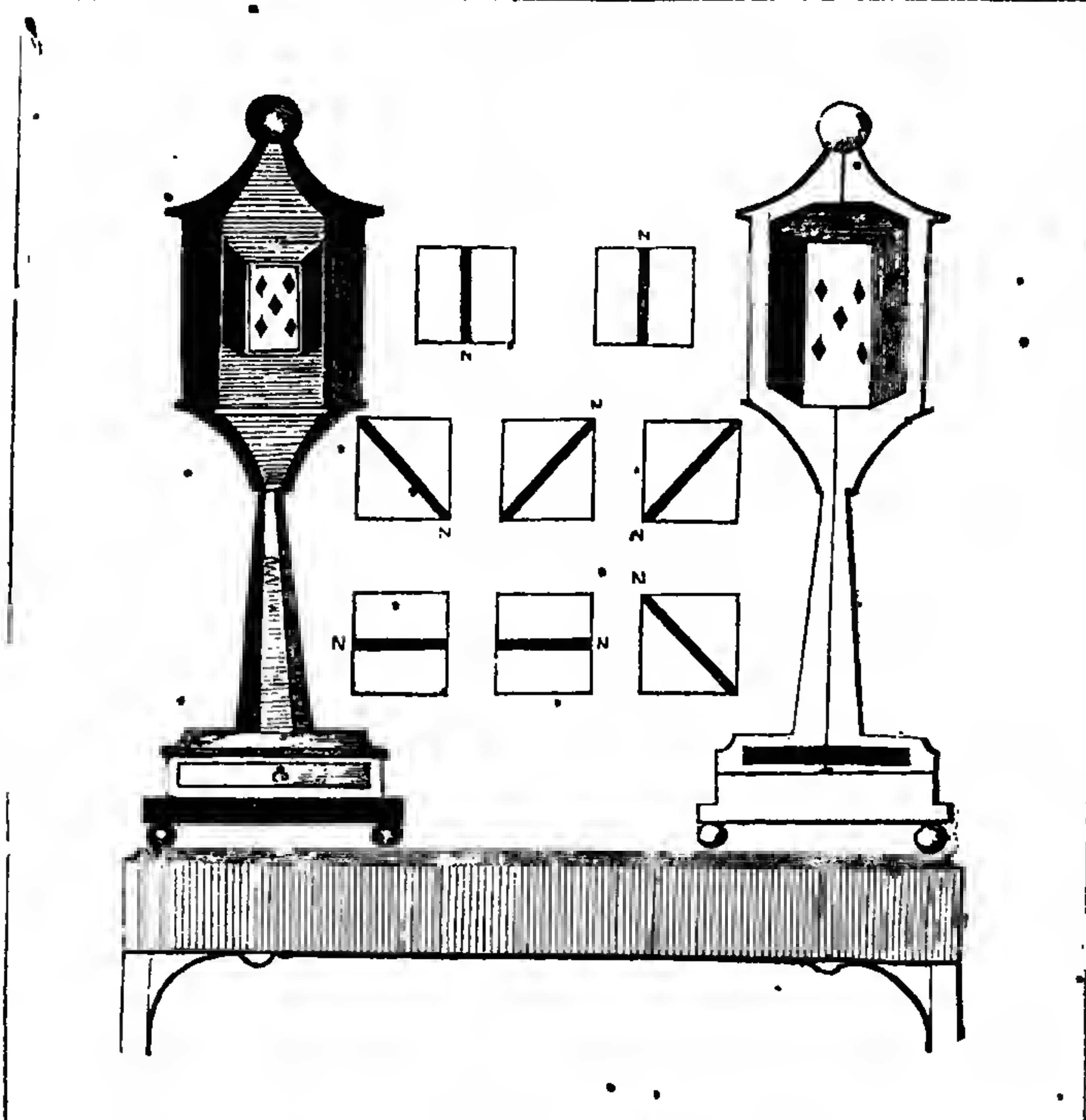
36—Why is it that certain ponds, lakes, and rivers, never freeze, even in the coldest winters? *Answered on page* 104.

37—What is the best method of bronzing iron or brass? *Answered on pages* 169 *and* [illegible]

38—What is the cause of magnetism? *Answered on page* 72.

39—Why is the rainbow a ring, and not a circular disc? *Answered on page* 78.

40—How are solar and lunar halos produced? *See page* 104.



MAGNETIC CONJURING BOX AND AUTOMATON SOOTHSAYER.

Among the admirable Automata, which were once exhibited at Bullock's Museum, and many years afterwards at Leicester Square, was one which attracted more than ordinary attention, and which was thought to have been one of the most complex of those wonderful machines, yet none of them was so simple in its moving powers. The Automaton alluded to was *The Conjuror*. The machine represented a cabinet: at the bottom of this was a drawer, into which a card could be placed. In the upper part of the cabinet was a pair of folding doors; and before it, at some distance, stood the figure of the conjuror, with a long white wand in his hand, and dressed in appropriate costume. The spectator had presented to him eight very thick cards, each with a particular question upon it; he was directed to choose one of the questions for solution to put into the drawer below, and then to close it. This put into action the motive machinery. The figure of the conjuror moved its head, appeared to ponder for a moment on the answer to be given, waved his wand, and struck it against the small folding doors above him. These immediately flew open, and displayed, on a tablet within, the proper answer.—In a short time the doors closed again, and the lower drawer was projected forwards, ready for the card that had been placed there to be removed, and another substituted.

The whole of the motions here are of obvious character; the heads and arms of the figure, the opening and closing of the doors, involves no very great complexity of wheel-work. The answers to the questions are given by means of magnetism in the simplest manner. and will be easily understood by the following description of the apparatus above represented, which has been called the

MAGNETIC CONJURING BOX.

One of the two figures in our cut represents this box closed, and in use: it is to be supposed that the five of diamonds has been placed in the drawer seen at the lower part of the box, and that the folding doors have flown open, and shown within them a corresponding card. The other view displays the same box in section, the slides next the eye being removed. On the lower part, just above where the drawer slides in, will be seen a magnet, suspended and moveable round it. This carries with it the wire, which is seen running upwards through the box, and which bears upon it an eight-sided prism or drum, each side of which corresponds with the loose cards which are to be put into the drawer, or else answers to any questions which may be written upon them. The eight cards, represented as squares in the engraving, have a magnetic needle passing through them, each in a different direction, and which is concealed by the paper covering them. When one of these is put within the drawer, and that closed, it will be brought beneath the revolving magnet in the box itself, and the latter magnet, being alone capable of motion, will range itself parallel to the fixed one in the card, consequently will draw round with it the drum or prism, which is fixed to the centre wire above, and according to the position of the magnet below so it will offer one or other of its sides to the folding doors, with the answer looked for.

The letter N in the figure indicates the north pole of the magnets within the cards.

THE AELLOPODES.

One or two exhibitions lately in London, of carriages to be propelled by human means, have renewed a subject which in the time of the velocipedes engrossed universal attention. The projectors of many of these schemes unfortunately set to work with less knowledge than zeal—not calculating before hand, by strict mathematical principles, the result of their inventions, and forgetting that it is not those schemes that look *prettiest* on paper, nor even the most effective models either, that in practice are found best to succeed. Pseudo-mechanics too often forget that they cannot make power; all they can do is to apply to the best purpose the force given them, by, in the first place, generating as much as possible from given materials, and afterwards to lose as little as possible of it by friction; that is, by the weight, the bearings, and the complexity of their machinery, as the ultimate application of that force will allow.

We are led to these remarks by a most ridiculous machine, now exhibiting in London, called "The Aellopodes," the invention of a Mr. Revis, of Cambridge, who is so sanguine respecting its excellence as to suppose that it may be used with advantage for cross country posts, and afford a saving to the Post Office of £60,000 per annum. The machine consists of two wheels of about six feet diameter, fixed upon an axletree, bearing four cranks, with a smaller guide wheel, some feet in front. The motive power is a man's weight, working upon two treddles, (three or four treddles in the machine,) which are connected with the cranks on the axletree, by means of bent levers passing to the back of the carriage. The whole machine is twelve feet long, weighs, if we understand rightly, about 1¼ cwt., and costs £30 in its construction. The man who works it remains in a standing position, holding a handle connected with the guide wheel in front, and treading alternately upon two of the treddles; the motion given to them is communicated by the bent levers to the cranks, and thence to the larger wheels, the friction of which on the ground causes the locomotion of the whole.

Mr. Revis says—"that this carriage will go thirty miles an hour," and perhaps upon a *floor* it may do so readily; yet to accomplish even twenty miles upon the smoothest roads, must require the most toilsome and unremitted exertion—what will necessarily be the effect when upon one which is rough or muddy, where the friction will be four, or more, times greater? If such impediments to motion are found with an unloaded carriage, as it is evident with the increase of them whenever the carriage may be loaded with 2 or 3 cwt. of letters and newspapers, shows how little available the aellopodes are likely to be to any useful purpose, especially as on hilly ground the inventor himself does not expect it will pass over. Added to which, its expense of manufacture is great—its size exceedingly cumbrous—and its weight too much. When in motion producing such a rattling of iron-work as to be in the highest degree disagreeable, and to those travelling the same road by horse conveyance dangerous. Besides which, the motion (which is similar to ascending a very steep staircase, with steps eighteen inches high) is so laborious, that we believe it impossible for the most powerful man long to sustain it. The intense labor, indeed, at the treadmill shows such exertion, long continued, to be beyond human strength, and in the instance of this machine to go at a speed of thirty miles an hour, as each step propels it eighteen feet, the driver must take 8,800 such tremendous steps in that time, lifting up his body each step, eighteen inches, and altogether within one hour to a perpendicular height of two miles and a half.

MATERIALS USED FOR PAPER.

It was long after the art of writing was first invented, that mankind employed any substance analogous to our paper. Tables of stone, of metal, or of wood, served to register the most important events or laws—the letters being engraven upon them with sharp instruments. Many examples yet remain of this, particularly the Egyptian hieroglyphics, the Persepolitan cylinders, and the Babylonish bricks—engraven, indeed, with a language now unknown. Tablets, coated with wax, probably succeeded, for they are alluded to very frequently by the Roman writers. It must have been, however, at a much earlier period than the foundation of the Roman empire, that real paper was made by the Egyptians from the papyrus (a reed growing in the Nile), as their mummies, even from the most ancient period, have often had preserved with them rolls of the papyrus paper, graven with emblematic characters. This was the material employed by Virgil, Horace, Ovid, and other of the Roman poets, to write their important works upon; and, during this Augustian age, the quantity of papyrus paper imported from Egypt, yielded a large profit to the manufacturers. So great, indeed, at one time, was the consumption, that the demand became greater than the supply, and *parchment* was invented in Pergamos, Asia Minor, to supply the deficiency.—This was about two centuries before the Christian era. It afterwards totally superseded the use of papyrus paper, and remained, throughout Europe,

for many ages the sole meterial for writing upon yet its establishment as such was very slow. Even down to the seventh century papyrus was, more or less, employed. As a proof of its extensive use at one period, it may be mentioned, thet there are in the musenm of Naples, 1800 MSS. written on this material, which were all dug out of the lava that entombed the city of Herculaneum, though but a small part of the city is yet excavated. The supply of parchment was, at some periods, so scanty, that the monks obliterated the writings of more ancient authors in order that they might themselves use the sheets a second time. Cotton paper succeeded, which useful article was far superior to any former material. It is supposed to have been first made in the tenth century, though the exact date is doubtful. Pliny, Livy, and others, mention *libri lintea*, or linen books; these were woven linen, painted after the manner of oil-cloth.

Doubtful, however, of the time of introduction of cotton paper, M. Mierman, in the year 1762, offered a reward for the discovery of the most ancient manuscript written upon it. The documents produced in consequence, induced him to fix the introduction of cotton or linen paper to about the year 1270, and other documents since discovered carry the manufacture at least fifty years earlier.

While this was doing in Europe, China was using bamboo for the same purpose. Tartary was learning the art from them, and the Arabs bringing it still more westwardly—the latter nation using linen, and the Tartars cotton, instead of the bamboo of the Chinese.

England was amongst the last European countries in which paper was introduced, it not having, in general, been used here till so late as the beginning of the fourteenth century, and it is only 150 years since writing paper became an article of home manufacture. Now we are not only independent of foreign nations for a supply, but export it to a considerable amount. In the year 1836 nearly five millions of reams of paper were made in this kingdom.

Writing and Printing Papers.—In the manufacture of these, England excels her continental neighbours. They are whiter, thicker, smoother, and bear a better face: but it is to be feared, that, in durability, the present paper is very far inferior to that made here in former periods, or at the present time in Germany and France. The laid papers, particularly foolscap and the thicker kinds, used for account books, is mostly made, in sheets of regular sizes, by hand, and of white linen rags only. It is, therefore, firm, regular in texture, and preserves well its color. The papers used for printing vary much in these qualifications. They are made almost entirely by machines in sheets of miles even in length, which extraordinary sheets are afterwards cut up to the requisite sizes. Flax and cotton rags, both white and colored—the refuse of cotton factories, hemp, and paper formerly used, and many other similar substances, are made available in the making of this class paper, and as may be expected great variation of quality is the result. The sizes of the sheets vary considerably, and are known by the names of pot, foolscap, post, demy, royal, double crown, &c.

Tissue Paper.—The principal consumption of tissue paper is in the Potteries, the designs for the various articles being printed first upon it, and then transferred to the half-baked clay. The English tissue paper is infinitely preferable to that made by any other nation, for its suppleness, strength, and regularity of texture. It is all machine paper, and is made only of two sizes, called tissue and double tissue.

Plate Paper.—This is made of a thick substance, and is left unsized that it may better take the impression of those fine lines which constitute the beauty of engravings. The English paper is good, when compared to the German, but is excelled by the French, particularly that used for large engravings. The desiderata looked for is to keep its color, to be strong when dry, and pliable when moderately wet—several sizes are manufactured bearing the same names as printing papers.

Drawing Papers.—Very great care is requisite in the making of this kind of paper, that the surface may be perfectly smooth, equally sized, and that no chemical ingredient be employed which can, by possibility, injure the exact tint of color which the painter may wash over it. It is requisite, also, that a long exposure to light and air shall not turn it yellow. It is always made by hand. Its various names, dimensions, and average price per sheet, are as follows:—in considering which it may be observed, that drawing papers are made of a thickness in proportion to their respective sizes, which is not the case with other kinds.

	Inches		In.		₩ Sheet.	
Demy measures	20	by	15	—	0*s.*	2*d.*
Medium..........	22		17		0	3
Royal............	24		19		0	4
Super Royal	27		19		0	5
Imperial..........	30		21		0	6
Columbier	34		23		0	9
Atlas	33		26		0	9
Double Elephant ..	40		26		1	0
Antiquarian	52		31		3	6
Extra Large Ditto..	56		40		4	6

ELECTRICITY.

(*Resumed from page* 12.)

In the experiments on excitation, (as given on pages 3 and 10.) three things are to be considered.

First—How is it that, if the electric fluid is so easily excited, its effects are not always visible?

Secondly—How can these various effects be attributed to the same cause?

Thirdly—What is the real cause of them, or of electrical effects in general?

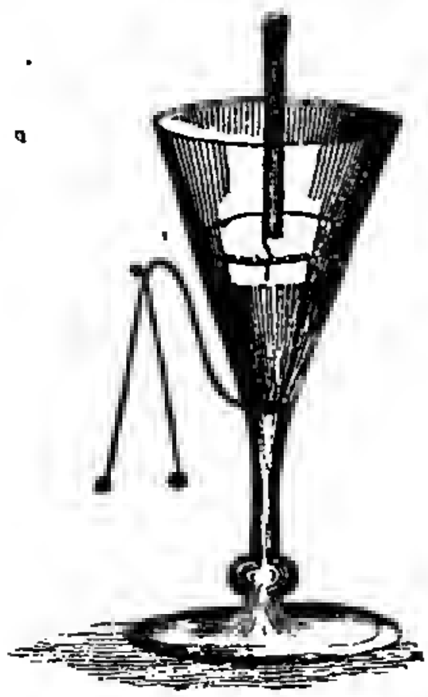
This last proposition we may now discuss. The others will need for their full elucidation the electrical machine. We refer, therefore, under the first and second heads, to the forthcoming chapters on electrics and conductors, and electrical attraction and repulsion. We have now rather to do with

THE CAUSE OF EXCITATION.

It will have been observed, that, wherever we have shown friction, there has also been separation of contact; and upon a strict examination it will be found, that, although the rubbing of two dissimilar bodies together may, and does occasion the electric fluid to be disturbed, yet it is only when these bodies are held apart, that each is found to put on electrical appearances. We say each, for although only one may appear excited, yet it will soon become apparent that both are equally affected, though in a different manner, as will be explained hereafter. Thus, in *Ex.* 1, the brown paper is the one body, and the coat the other. In *Ex.* 7, the ribbons are excited by the hand, and it is when the hand is drawn away from them that they show themselves

electrical; so also in *Ex.* 8, the comb passing over the hair must certainly be separated in turn from those particular parts it touches in its course along, and not till then is it seen that those parts are electrical; and thus in every experiment there is not merely friction, but separation of the parts rubbed together, where it is not so no electrical appearance would be perceived, as is clearly proved by

THE SULPHUR CONE.



The apparatus figured above is formed from a large wine or ale glass. This is cleaned, and a part of the outside, as represented, covered with tin foil. A wire is twisted round this covered part, and bent so as conveniently to hold a pair of pith balls suspended on very fine wires, or on linen threads.—Withinside the glass is to be poured melted sulphur, to about the same height, or a little above the edge of the tin foil, and the end of a glass rod, or else of a silk cord, dropped into the sulphur while melted.

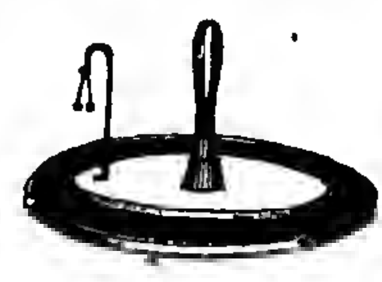
Ex. 23.—Lift up by the glass, or silk handle, the sulphur within the conical glass, and, at the moment of separation, the pith balls will diverge, or separate from each other. Let the sulphur drop down again into the glass, and this action of the balls will cease. Again produce separation of contact, and they will again diverge; and thus, for a considerable time, the alternate action will be kept up, even indeed for days and weeks.

Ex. 24.—Take a piece of glass, about five inches long by three inches broad—warm it, wrap tin foil all over it, and rub the outside of the tin foil smartly with the hand. The glass thus excited, held to the cap of Bennett's gold-leaf electrometer, will not show any electrical effect while it remains wrapped in the tin foil, but if this be removed, and the glass alone be presented, the gold leaves will instantly diverge.

Ex. 25.—Varnish over one side of a piece of glass —when quite dry and hard, scrape off some of the varnish with a knife, on to the cap of the electrometer. The electric fluid, rendered apparent by the separation of contact between the varnish and glass, will be indicated as before, by the divergence of the gold leaves. Were it needful to illustrate this principle more strongly, the experiments with the *Electroporus* and *Circular Rubbin Machine* are conclusive.

THE ELECTROPHORUS.

Which may truly be called the cheapest and simplest electrical machine, which is of real value, is described, and may be made as follows:—Procure a round piece of tin, about ten inches over, and have the edge of it turned up about a quarter of an inch, so as to be capable of holding some of the following mixture, (melted over a fire,) one pound of yellow rosin, and two ounces of wax. This being poured into it, and suffered to cool, one part of the electrophorus will be complete. Next provide a round plate of wood, about half an inch thick, and six or seven inches over, which must have a smooth edge, and without any sharp points or angles, cover this with tin foil, and fix a glass rod to the middle of it as a handle. This may, altogether, cost two shillings, and is a really useful electrical machine, capable of showing all the fundamental facts of the science. The following cut will, it is hoped, render the description more evident.



Ex. 26.—To excite it, warm and wipe the glass handle, and also the resinous plate. Rub this briskly with a warm flannel, and put the wooden plate upon it, holding it by the glass handle—touch the wooden plate for a moment with the finger, and it will be full of the fluid in a disturbed state, not, however, apparent until the wooden plate is lifted up, when a spark may be taken from it—put it down again, touch it with the finger, and lift the plate up again, (first removing the finger,) and a second spark may be taken, and so on for a considerable length of time.

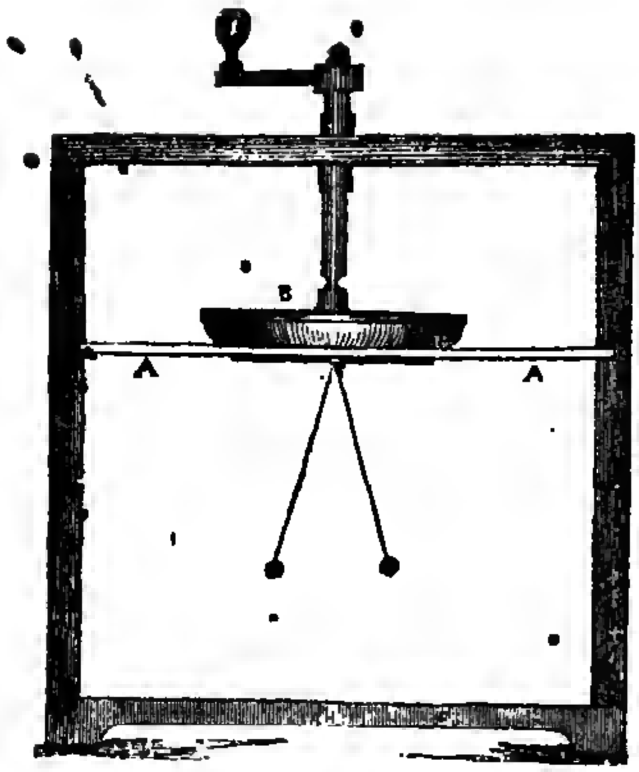
Ex. 27.—Fasten near to the edge of the upper plate of the Electrophorus a bent wire, bearing on the end of it two suspended pith balls—whenever the upper plate is removed from the lower, both being excited and touched with the finger, as above directed, the pith balls will be violently repelled from each other.

Ex. 28.—If the resinous plate be excited and placed upon a glass stand, and two pith balls be suspended from the rim of it—whenever the upper plate is lifted up, these balls also will diverge, showing that the lower plate only appears excited, when separation of contact ensues.

THE CIRCULAR RUBBING MACHINE

Consists of a square frame of wood, supported by a square foot, having a circular rubber or cushion stuffed with flannel and covered with leather, which is turned by a handle at top. This rubber rests upon a plate of glass, about eight inches in diameter. The under surface of the glass has pasted upon it a round piece of tin foil, three or four inches over, with two pith balls hanging by fine wires or a thread from the centre of it.

Ex. 29.—Prepare the apparatus by warming the the glass, and spreading a little *amalgam* on the cushion—turn round the handle, which will produce a friction, and excite the glass. In this state there will be no appearance of the fluid being disturbed, until the cushion be lifted up, when the balls will diverge—placing it down again their motion will cease, and thus they may be alternately moved, by producing and separating contact.



Amalgam.—Melt in a ladle half an ounce of zinc. When melted, add and stir up with it two ounces of quicksilver. When cold pound it with a little wax or grease, when it will be fit for use

(*Continued on page* 57.)

THE RESPIRATION OF ANIMALS AND VEGETABLES.

There is no subject which exhibits the economy of nature more beautifully than the one under consideration. It is a curious and interesting fact, that those constituents of atmospheric air which are obnoxious to animal life are found to be of the highest consequence to the preservation of the health and life of vegetables, so on the other hand, that given off by growing vegetables is of vital importance to animal existence.

When an animal is confined in an air-tight vessel containing atmospheric air, the oxygen (its vital principle) gradually becomes diminished until the inclosed air is no longer able to support life. If, then, we examine the contents of the vessel, they will be found to be composed chiefly of nitrogen and carbonic acid gas. This last mentioned gas, together with oxygen, are the only ones which contribute to vegetable existence. It has been proved that oxygen is evolved, and carbonic acid gas absorbed by vegetables in the sunshine, and *vice versa* in the shade. It is, therefore, important that the component parts of the atmosphere should be in such proportions that not only animals, but also vegetables, may flourish under its influence. So immense is the consumption of oxygen that an ordinary-sized man consumes 46,000 cubic inches of it per day, which is equivalent to 125 cubic feet of atmospheric air. Were it not for the important provisions of nature, which preserves the atmosphere unchanged, by replenishing the gases consumed, the destruction of all urganic life must inevitably ensue. Some curious experiments of Spallanzani show the lungs are not the sole organs by which animals respire. He found that amphibis, deprived of their lungs, lived much longer in the open air than others in air destitute of oxygen. It is a remarkable fact that a larva, weighing a few grains, will consume almost as much oxygen in a given time, as one of the amphibia one thousand times its bulk.—W. B.

[The statements in the above paper are not wholly correct as to the gases absorbed and given out by vegetation; they imbibe, perhaps, as much oxygen at one time as they part with at another, and decaying plants contaminate the atmosphere infinitely more than purify it, as is proved by growing plants in glass cases, were though there may be more oxygen by day, and carbonic acid by night, yet a general average is maintained. Many tribes of plants, also, imbibe nitrogen. Thus it is with most of those which have a foetid odour, as the *Chenopodium olidum*, or Stinking Goose-foot; all of the Cabbage tribe; and particularly the Toads'-tools and other Fungi. When in decay, ammonia, sulphuretted, and sometimes phosphuretted, hydrogen, is given off in considerable quantities. Thus the comparative benefit and injury of vegetation to the atmosphere is a most difficult question to decide. We must not either depend so much upon plants absorbing the carbonic acid of the air; almost all earthy bodies contain it, and most of them absorb it much more rapidly and extensively than is done by vegetables.—ED.]

PARAGUAY TEA.

The tea tree of Paraguay, called in the country *yèrva mate*, is one of the most useful trees in Paraguay, to which it is nearly peculiar. It is found growing spontaneously, intermingled with the other native trees, in the forests which cover the banks of the rivers, and streams which fall into the Parana and Uruguay, as well as the sources of the rivers Ipane and Jejui. The tree is large, and often equals in size the common orange tree; but in the places where the leaf is regularly gathered, it becomes stunted, from the limbs being cut every two or three years, but not oftener, owing to an opinion that this time is requisite to season the leaves, which do not fall off in winter. The trunk is about a foot in diameter; the bark is smooth and whitish; the boughs, which spring upwards like those of the laurel, are leafy and tufted. The leaf is elliptic, cuneiform, from 4 to 5 in. long; thick, glossy, crenated, of a dark green above, and paler below. The petiole is of a dark red, and half an inch long. Its flowers are produced in umbels of thirty or forty flowers each, with four petals, with the same number of stamens. The berry is red, very smooth, and of the size of a small pea.

The method of preparing the leaves is as follows: —A hurdle of long poles is constructed, in the form of a cylindrical vault, which they call barbaqua; under this a large fire is made, and the branches being placed on the hurdle remain there till the leaves are sufficiently dry. After this they remove the fire; and on the hard and hot platform, after being swept clean, they throw the branches, which they beat to separate the leaves. In this each is assisted by a boy, called a quayno, who receives the proportion of 25 lbs. of leaves for every bundle of branches he cleans; the leaves being separated from the branches, and prepared sufficiently, are next put into a large bag made of hides, which has the four upper corners fixed to four large stakes placed in the ground, fitted to support a considerable weight; into this they put the leaves, and beat them down with a pole, in the same way as the negroes of the West Indies pack their cotton bags. When the bag is filled and packed hard, the mouth is sewed up; and in this state, without farther preparation, the leaves are fit

for use, but not considered as seasoned till they are a few months old

We find, in the beginning of the seventeenth century, that this plant was in common use throughout Paraguay; and there can be no doubt but the Indians of Mondsy taught it to the conquerors, from their being the natives who lived in the vicinity of the forest. The quantity used by a person who is fond of it is an ounce. The amount daily gathered by a labourer is from four to twelve, and sometimes more, arrobas. There are among the creoles or mestizoes many who falsely charge the Paraguayans with having exterminated the Indians by making them work at this labour.

These leaves are used in Paraguay, La Plata, Peru, and Quito, at all hours of the day, by putting a handful into a kind of tea-pot called mate (which has given its name to the herb), and from the spout of this the hot liquid is imbibed. Some mix sugar with it, and others add a few drops of lemon juice; and by pouring fresh boiling water the infusion may be renewed. 200,000 arrobas, equal to five millions of pounds, are annually obtained from Paraguay, 110 arrobas of which go to Chile, whence Lima and Quito are supplied; the rest is expended in the vice-royalty of Buenos Ayres.

There are three kinds of it in its prepared state, though produced but by one plant. Caa is the destinctive Indian appellation of the plant; and the three sorts are called caa-cuys, caa-mini, and caa-guazu, the last being denominated by the Spaniards yerva de palos. The people of South America attribute innumerable virtues to this plant. It is certainly aperient and diuretic; but the other qualities ascribed to it are doubtful. Like opium, it produces some singular and contrary effects: it gives sleep to the restless, and spirit to the torpid. Those who have once contracted the habit of taking it, do not find it an easy matter to leave it off, or even to use it in moderation; though, when taken to excess, it brings on similar disorders to those which are produced by the immoderate use of strong liquors.—*Wilcocke's History of Buenos Ayres.*

ON THE INVISIBILITY OF CERTAIN COLORS TO CERTAIN EYES.

A VARIETY of cases have been recorded, where persons with sound eyes, capable of performing all their ordinary functions, were incapable of distinguishing certain colors, and what is still more remarkable, this imperfection runs in particular families. Mr. Huddart mentions the case of one Harris, a shoemaker, at Maryport, in Cumberland, who could only distinguish black and white; and he had two brothers almost equally defective, one of whom always mistook orange for green. Mr. Harris observed this defect when he was four years old, and chiefly from his inability to distinguish cherries on a tree like his companions. He had two other brothers, and sisters, who, as well as their parents had no such defect. Another case of Mr. Scott is recorded in the "Philosophical Transactions," in which full reds and full greens appeared alike, while yellows and dark blues were very easily distinguished. Mr. Scott's father, his maternal uncle, one of his sisters, and her two sons, had all the same imperfection. Our celebrated chemist, Mr. Dalton, could not distinguish blue from pink by day-light; and in the solar spectrum the red is scarcely visible, the rest of it appearing to consist of two colors, yellow and blue. Dr. Butters has described the case of Mr. R. Tucker, son of Dr. Tucker, of Ashburton, who mistakes orange for green, like one of the Harrises. Like Mr. Dalton, he could not distinguish blue from pink; but he always knew yellow. The colors in the spectrum he describes as follows:—

1. Red mistaken for................brown.
2. Orange.......................green.
3. Yellow, generally known, but sometimes taken for.................orange.
4. Green mistaken for..............orange.
5. Blue..........................pink.
6. Indigo.......................purple.
7. Violet.......................purple.

Mr. Harvey described, in a paper read before the Royal Society of Edinburgh, the case of a person aged 60, who could distinguish with certainty only white, yellow, and grey. He could, however, distinguish blues when they were light. Dr. Nichols has recorded a case where a person who was in the navy purchased a blue uniform coat and waistcoat, with *red* breeches to match the *blue*, and he has mentioned one case in which the imperfection is derived through the father, and another in which it descended from the mother.

In the case of a young man in the prime of life, with whom the writer of this article is acquainted, only two colors were perceived in Dr. Wollaston's spectrum of five colors; viz. orange, red, green, blue, and violet. The colors which he saw were *blue* and *orange* or *yellow*, yet he could scarcely distinguish these two from one another. When all the colors of the spectrum were absorbed by a reddish glass, excepting *red* and *dark green*, he saw only one color, viz. yellow or orange. When the middle of the red space was absorbed by a blue glass, he saw the black line with what he called the *yellow* on each side of it. We are acquainted with another gentleman who has a similar imperfection.

In all the preceding cases there is one general fact, that red light, and colors in which it forms an ingredient, are not distinguishable by those who possess the peculiarity in question. Mr. Dalton thought it probable that the red light is, in these cases, absorbed by the vitreous humour, which he supposes may have a blue color; but as this is a mere conjecture, which is not confirmed by the most minute examination of the eye, we cannot hold it as an explanation of the phenomena. Dr. Young thinks it much more simple to suppose the absence or paralysis of those fibres of the retina which are calculated to perceive red; while Dr. Brewster conceives that the eye is, in these cases, insensible to the colors at the one end of the spectrum, just as the ear of certain persons has been proved, by Dr. Wollaston, to be insensible to sounds at one extremity of the scale of musical notes, while it is perfectly sensible to all other sounds.

If we suppose, what we think will ultimately be demonstrated, that the choroid coat is essential to vision, we may ascribe the loss of red light in certain eyes to the retina itself having a blue tint. If this should be the case, the light which falls upon the choroid coat will be deprived of its red rays, by the absorptive power of the blue retina, and consequently the impression conveyed back to the retina, by the choroid coat, will not contain that of red light.

REVIEW.

Elements of Drawing and Perspective. By John Clark. Published in "Chambers's Educational Course."

Elements of Drawing and Painting in Water Colors. Published by the same Author, as a Supplement to the above.

No class of books is generally written in so vapid a style, and contain so little really practical information, as those upon this subject. It is true that drawing is an art to be learned only by labor, and after reiterated attempts; but surely something more than "the metaphysician's rules, which only teach to name his tools," might be found for the assistance of the tyro. His taste should be directed to proper subjects, and his difficulties anticipated.—Although the mechanical operations must be explained in detail, yet combined with them might be given the sound philosophical principles of harmony, of effect, and of proportion. In the two works now in our hands, every page shows that they were written by a man of real knowledge and taste. The first is full of valuable matter, that some of our drawing masters would do well to study, and that no student should be an hour without; it will communicate more real information on the arts of drawing and perspective than perhaps he may ever otherwise obtain.

The other work, which is embellished with numerous colored plates, is in style and matter as admirable, and would enable any persons to perfect themselves in water-color painting, in all its branches and applications, without any other instructor: for, as the author says, "he has been anxious to lay a foundation in the mind of the student by the exposition of sound principles of art." The following extract will, we are sure, be read with pleasure by those who are not, as well as those who are artists:—

"Many conflicting opinions have prevailed, with respect to the propriety of introducing groups of human figures in landscapes; but the difference of the artists on this point has not led to any decision of the question.

"It may be alleged, with some show of reason, that too many figures have a tendency to disturb the requisite repose of a beautiful scene; but, on the other hand, the want of figures most certainly tends to excite an idea of desertion, if not of desolation.

"A medium between these two extremes may, perhaps, be the most judicious and comformable to good taste. Figures, for example, are natural and proper on a road; they are useful as a scale of measurement, to which to refer surrounding objects, as tall trees or lofty buildings; they conduce to the interest of particular scenery, and serve to characterise it; and they may be made to communicate historical interest to a picture otherwise rich, as is well exemplified in some of the admirable and too-much neglected pieces of Wilson. Groups of figures may often be seen in the pictures of Teniers, Wouvermans, Claude, and Cuyp, who seldom omitted to embellish their landscapes in this way with conspicuous assemblages of figures. Claude's magnificent and gorgeous edifices, indeed, would appear solitary and quite out of character with the whole piece, had be omitted to introduce his holiday groups of people, or a crowd of worshippers going to or returning from his temples.

"Supported by such authorities we may well consider figures an excellent adjunct for imparting richness and color to foregrounds, and as useful for detaching masses or distances, bearing always in mind, that whatever figures are introduced must accord in character with the other parts of the piece.

"'Landscape,' says a judicious author, quoted by Smith in his *Life of Wilson*, 'however dignified, however picturesque, is, unless animated by human figures, far from complete. The mind is soon satisfied with the view of rock, of wood, and of water; but if the peasant, the shepherd, or the fishermen be seen, or if, still more engaging, a group of figures be thrown into some important action, the heart as well as the imagination is affected, and a new sensation of exquisite delight, and scarcely admitting of satiety, fills and dilates the bosom of those who,—either with the pen or pencil, combining the energy of human action with the awful and romantic scenery of a wild, or with the softened features of a cultivated country,—secure and have a claim to reputation. The banditti of Salvator Rosa, the interesting groups and figures of Poussin, and the rustic simplicity of Gainsborough, unite with the surrounding views of nature, in effecting an impression of the utmost power, and not otherwise procurable.'

"Taste is not subject to fixed rules, but natural landscapes are luminous, although artists of celebrity have reduced the light to one-eighth of the size of their subject; and a dark picture requires an excellent situation in which to be viewed, or much of its beauty will be lost. There is a cheerfulness associated with a landscape in light, which should lead the student to sustain this character in a piece, unless it be particularly desired to introduce subjects of a solemn character. Rembrandt is the only master who obtained celebrity in landscape by painting artificially, and otherwise than nature dictated.—Claude, Poussin, Vernet, and Gainsborough, painted in the fields, and their representations are expansive breadths of light, and strikingly beautiful.

"After all, while artists have pursued their own ideas, and produced innumerable pictures of extraordinary talent for our gratification and instruction, those are most esteemed who sought not to dazzle, but—

> "'Mixed their tints,
> And called on chaste simplicity.'"

MISCELLANIES.

Preparation of Caustic Potash.—If one part of carbonate of potash be dissolved in four parts of water, and the solution be boiled with slaked lime, the potash does not lose the smallest quantity of carbonic acid; it does not become caustic, even though lime be added to any extent, or however long the boiling may be continued. If, however, six parts of water be gradually added to the above mixture, it will be found, and without further boiling, that the potash loses its carbonic acid gradually; and that after the addition of the last portion of water, the potash is perfectly caustic. If the water be added at once the potash becomes very quickly caustic.

This peculiarity is explained by the fact, that concentrated caustic potash takes carbonic acid from lime. This fact is readily proved by boiling powdered chalk with concentrated potash, entirely free from carbonic acid; the solution added to muriatic acid occasions brisk effervescence. M. Leibig states, that the carbonate of potash which is to be made caustic should be dissolved in at least ten parts of water.—*Ann. de Chimie.*

To make Ottar of Roses.—Take a very large earthen or stone jar, or a large clean wooden vessel. Fill it with the leaves of the flowers of roses, very well picked, and freed from all seeds and stalks—pour upon them as much pure spring water as will cover them, and set the vessel in the sun in the morning at sun-rise, and let it stand till the evening, then take it into the house for the night; expose it in this manner for six or seven successive days, and at the end of the third or fourth day, a number of particles of a fine yellow oily matter will float on the surface, which, in two or three days more, will gather into a scum, which is the *ottar of roses.* This is taken up by some cotton tied to the end of a piece of stick, and squeezed with the finger and thumb into a small phial, which is immediately well stopped; and this is repeated for some successive evenings, or while any of this fine essential oil rises to the surface of the water. This oil is said to be sold at a guinea a drop in the East Indies. The monks of St. Mark's Convent, at Florence, are said to have made very good ottar of roses for about eight pounds sterling per ounce.

Re-production of Statuary.—A French artist, M. Colas, has found the means of applying to sculpture a process which has much connection with M. Daguerre's invention. By this contrivance the Venus of Milo, for instance, is identically re-produced in all its dimensions, from the original size of the statue to the *statuette* of three feet, an inch, or even six lines; and, moreover, it may be done in marble, stone, ivory, wood, alabaster, &c. M. Colas's process employs the hardest as well as the softest substances, and his copies of statues and bas-reliefs are so complete that the imperceptible alterations of the marble worn by time are exactly re-produced.

Singular Experiments with Glass Tubes.—A most remarkable phenomenon is produced in glass tubes under certain circumstances. When these are laid before a fire in a horizontal position, having their extremities properly supported, they acquire a rotatory motion around their axes, and also a progressive motion towards the fire, even when their supports are declining from the fire. When the progressive motion of the tubes towards the fire is stopped by any obstacle, their rotation still continues. When the tubes are placed in a nearly upright position, bearing to the right hand, the motion will be from east to west, but if they lean to the left hand, the motion will be from west to east; and the nearer they are placed to the upright posture, the less will the motion be either way. If the tube be placed horizontally on a glass plane, (the fragment, for instance, of coach-window glass,) instead of moving towards the fire, it will move from it, and about its axis, in a contrary direction to what it had done before; nay, it will recede from the fire, and move a little upwards, when the plane inclines towards the fire. These experiments succeed best with tubes about twenty or twenty-two inches long, which have in each end a pretty strong pin, fixed in cork for their axes.

Instantaneous Lights.—The oxygenated, or *chlorate matches,* are first dipped in melted sulphur, and then tipped with a paste made of chlorate of potass, sulphur, and sugar, mixed with gum water, and colored with vermillion. Frankincense and camphor are sometimes mixed with the composition, so that a fragrant odour is diffused by the matches in burning. To obtain light, a match is very lightly dipped in a bottle, containing a little asbestos, soaked in oil of vitriol. *Lucifers* consist of chips of wood, tipped with a paste of chlorate of potass, mixed with sulphuret of antimony, starch, and gum water. When a match is pinched between the folds of glass paper, and suddenly drawn out, a light is instantly obtained. *Prometheans* consist of small rolls of waxed paper, in one end of which is a minute quantity of vitriol, in a glass bulb, sealed up, and surrounded with chlorate of potass. When the end, thus prepared, is pressed so as to break the bulb, the vitriol comes in contact with the composition, and produces light instantly. For cigar smokers, Prometheans are made with touch paper, this ignites from the composition, and glows without flame, like a slow match, and as the wind will not extinguish it, a dry cigar may be readily lighted at it. *Congreves* have a small quantity of phosphorus mixed with the composition used for Lucifers, which renders them liable to be inflamed with much less friction. Rubbing them against a wall, the sole of a shoe, or even a board will inflame them.

Combustion without Flame.—Light a small green wax taper; in a minute or two blow out the flame, and the wick will continue red-hot for many hours, and if the taper were regularly and carefully uncoiled, and the room kept free from currents of air, the wick would burn on in this way till the whole taper was consumed. The same effect is not produced when the color of the wax is red, on which account red wax tapers are safer than green, for the latter, if left imperfectly extinguished, may set fire to any object with which they are in contact.—*Parlour Magic.*

Imitative Wax Candles.—Take equal parts of gum benzion and resin mastic; put each into a separate vessel of glass or lead, add spirit of wine, and heat them gently till the resinous parts are dissolved. Let each of the solutions remain awhile at rest, and then mix them. Before using this varnish, heat it to eighty or ninety degrees Fahrenheit; dip into it a candle from five to ten seconds, and dry it carefully. By this means, common candles may be made to resemble wax lights.

QUERIES.

41—Hyacinth and Narcissus roots grow more rapidly in colored, than in white glasses. Query, the reason.

42—What is the cause of parhelia, or mock suns, and paraselenæ, or mock moons? *See page* 104.

43—Paintings in imitation of mezzotinto are sometimes executed in lamp black and soap. What is the process?

44—What is the best mode of killing insects intended for specimens? *Answered on page* 72.

45—Does alcohol exist in any living vegetable? *Answered on page* 72.

46—Why do the sun and fixed stars shine by their own light, while the earth and planets by transmitted light only? *Answered on page* 72.

47—What is the cause of elasticity? *Answered on page* 412.

48—What is the the cause of attraction of cohesion? *Answered on page* 72.

49—What is the reason that the gold leaf, through which an electrical shock is passed, becomes embedded in the glass between which it is placed? *Answered on page* 72.

50—By photogenic drawing can any of the primitive colors be obtained besides the violet? *Answered on page* 72.

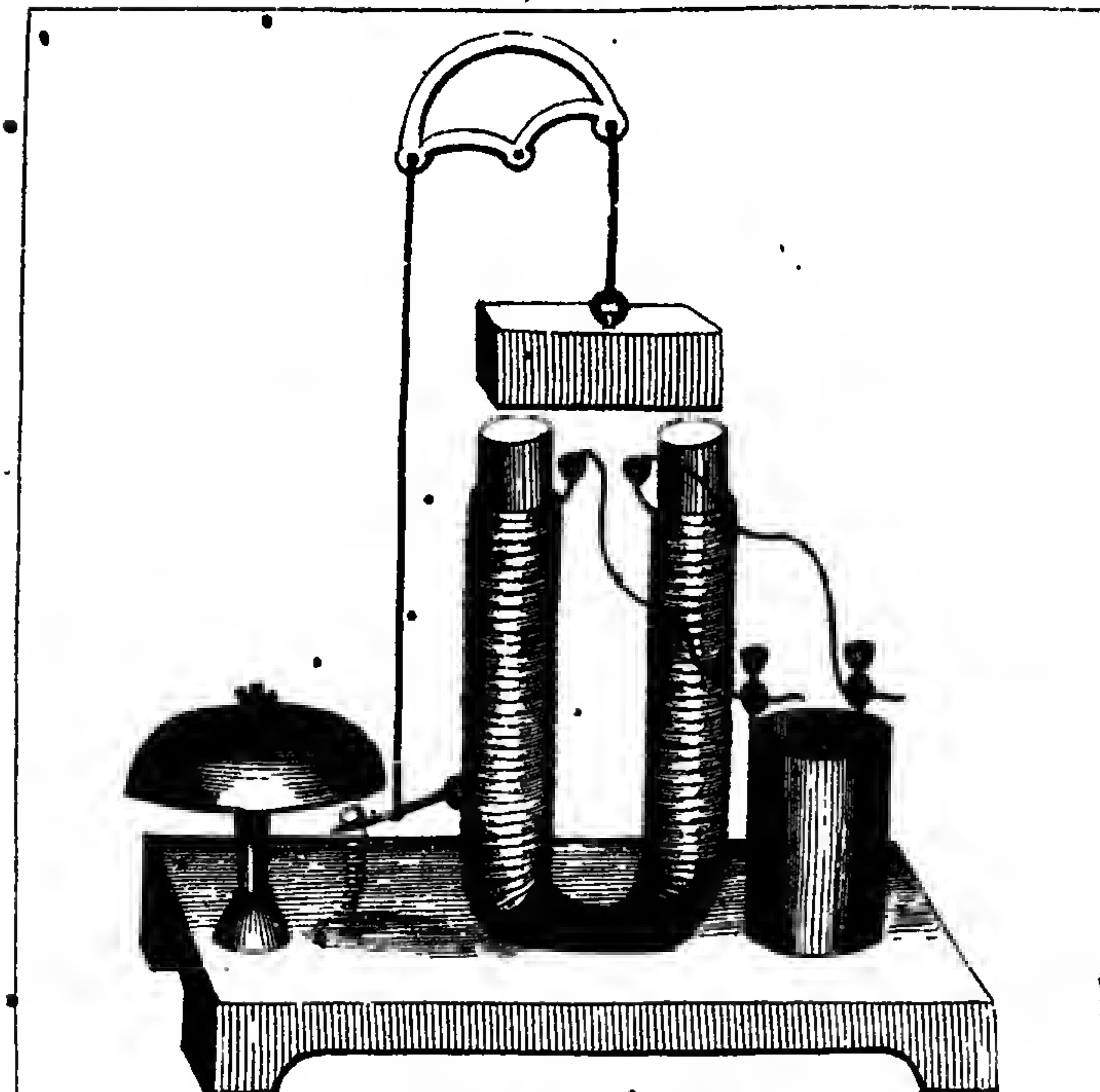
51—What is the composition of the marmoretum cement, as used by dentists? *Answered on page* 72.

52—Where are the clouds when the air is clear? *Answered on page* 72.

53—Why does the wind come in gusts? *Answered on page* 72.

54—Can fishes be said to breathe? *Answered on page* 72.

55—What is the reason that a man weighs heavier before dinner than after? [It is an error to suppose he does.—ED.]



TELEGRAPHIC ALARUM.

Nothing can mark more forcibly the power and value of the present inductive mode of philosophy, compared to the puerile and unlogical pursuits and opinions of the predecessors of Bacon, than the unlooked-for results which modern science have furnished. The abridgment of human misery—the rapid spread of communication and intelligence—and the vast additions to the happiness and well-being of society, which science in the last few years, has produced, will show how powerful is knowledge when well directed. In former times discoveries were few, and the result of accident alone. Now, every year yields up something valuable; something produced by a previous train of research, reasoning, and experiment. Each science does in its turn contribute its quota of machines, or of new and before unthought-of combinations of organic matter. Witness how mechanics and hydrostatics have been called into exercise in the steam engine, in locomotion, and in manufacturing machines. Chemistry has yielded us gas for our streets, and a thousand other new products. Even light, as we have seen, has been made an artist. The most intractable sciences, and even the apparently most insignificant experiments, have become in the hands of genius of great importance to mankind.

These thoughts have been forced upon us by two new machines, the one by Professor Wheatstone, to ring a bell, or signal, many miles off; and the other invented by Mr. Palmer, the optician, of Newgate Street. These ingenious machines are described as follows:—

TELEGRAPHIC ALARUM.

In telegraphic communications it is, of course, first necessary to engage the attention of the persons employed at distant stations, that they may either take down, or transmit forward, the signals made by the instrument itself. This is often attended with considerable difficulty, and requires that the looker-out should be constantly at his post of observation. To remedy the inconvenience, and to render his electrical telegraph completely effective, Professor Wheatstone has adapted a common electro-magnetic experiment to ring a bell at any distance, even one hundred miles off, and that without an instant's delay. The contrivance will be understood by the annexed engraving.

In the centre will be seen a horse-shoe shaped piece of soft iron, with its poles upwards, and having coiled round it a mass of covered bell wire, the ends of which are terminated by two mercury cups. Above this horse-shoe is seen a square piece of iron, hung from a bell crank, the other end of which communicates with the hammer of a bell, or alarum. On the other side of the engraving is seen a small galvanic battery, with two wires passing from it to the mercury cups of the apparatus. When the battery is in action, and connected with the mercury cups, a stream of the electric fluid will, of course, pass along the coiled wire, and make the soft bent iron bar within a temporary magnet. As such it draws down the weight above it. (This is suspended about a quarter of an inch higher than the poles of a temporary magnet.) In doing so the crank is acted upon, and communicates the motion to the hammer which strikes the bell—or if a running alarum be wanted, it would, by the same means, loosen the spring connected with it. When the connection with the battery is broken, the horse-shoe ceases to be a magnet, and therefore it no longer attracts the weight above: this, therefore, is pulled back to its former station by the spring seen under the bell hammer.

The success of this experiment in a room is obvious, but when the battery and magnet are seperated by many miles distance, it appeared not so certain, and upon experiment it was found that a temporary magnet could not be made, if the electric fluid had to pass so long a space. At the same time it was proved, that although it would not make a magnet so far off, yet that it would affect a magnet already made. Thus, means were afforded by science of overcoming what otherwise would have been an insurmountable difficulty. Professor Wheatstone contrived to affect a dipping needle by twisting round it the wire conveying the stream of electricity. The magnet thus acted upon and which was balanced horizontally before, dipped one of its ends, and in doing so carried down the ends of two wires connecting the machine with a battery placed as in our first figure close to it; and thus a galvanic battery at London instantaneously puts in action another at Bristol, only by means of two covered wires carried from the one place to the other.

Note.—To convey the electric fluid to great distances, for example as required in the Electrical Telegraph, common thick bell wires are coated with Indian rubber varnish: then tied together, and inclosed in a small iron pipe. This pipe has then poured into it a resinous cement; thus the wires are insulated, and covered with a material impervious to water, not liable to injury by frost, and little affected even by time.

PALMER'S PNEUMATIC FILTERER.

This ingenious and useful machine depends for its action upon the weight of the atmosphere, and is a modification of the well-known experiment of filtering mercury by placing it in a cup with a porous bottom, on the top of an open air pump receiver. The air being exhausted from beneath and the mercury pressed by the air above, percolates through the porous body in which it is placed, and is caught in a cup put within the receiver.

In Mr. Palmer's filterer there are two vessels soldered, or otherwise fastened air-tightly upon each other, in the manner of the usual coffee pot and strainer. The upper vessel has the bottom of it pierced with fine holes, and upon this is placed a sieve fitting close to the sides, and made of a metallic ring, with a piece of muslin tied over it. The lower vessel has a nozzle or tap to draw off the filtered coffee, and on the upper part a small exhausting syringe is screwed. The thick coffee being placed in the upper vessel, and the air in the lower one being drawn off by the syringe, the finer parts of the coffee are forced through the muslin and holes of the false bottoms, becoming beautifully clear, and fit for immediate use.

It takes about two minutes to filter a pint. The beverage may also be made with cold water as with hot, but as cold coffee is not very agreeable, the machines are furnished with a lamp beneath to heat it after filtering, but previous to this heating, or indeed to its being drawn off, it must be evident that the exhausting syringe should be removed, and the hole upon which it fastens left open.

This filtering machine is equally applicable to the purification of water, wines, mineral solutions, &c., as it may be made of any size, form, and material; and by it are avoided all the waste, annoyance, uncertainty and dirt, to which even the best stones, bags, and paper filters are necessarily subject. Thus a long known and long disregarded pneumatic experiment has suggested a highly useful, cleanly and philosophical instrument.

While upon the subject of filterers we may mention one which has been somewhat advertised lately, which is as inefficient and worthless, as Mr. Palmer's is valuable. The inventor is, we believe, a resident of Leeds, and has taken out a patent for it, under the name of

BEART'S PATENT FILTERER.

This consists of a perfectly cylindrical vessel, of copper or tin, about a foot high, and three inches in diameter. Within this is placed an air-tight collar, with a perforated bottom, and a very strong handle in the middle of it, so far distant, that when the air-tight collar, or piston, is at the bottom of the vessel, the handle shall be at the top. In this position, crude boiling coffee is to be put in. The whole machine to be put on the floor, and the handle by main strength pulled up—when it reaches near the top the finer parts of the coffee will have passed through the perforated bottom of the piston, and ready for use.

Some peculiarities here will strike the most incurious. A machine containing a scalding and steaming liquid is to be held on the ground between the feet: certainly not very pleasant for a lady, nor very preservative to her dress. Then to pull up the handle (as the air cannot penetrate below the piston) would require a force equal to the weight of the atmosphere, or 15 lbs. to the square inch, and in a piston 3-inches diameter, as is this filterer, the tractive force required would be 106 lbs., a tolerable weight for even a strong man to lift, taking no account of the scalding steam all this time. When the piston should have been pulled to the top, unless the utmost care be taken, the coffee grounds would be scattered with considerable force over the apartment; added to which the least dent or bruise in the vessel renders it immediately useless; and as the tractive force requisite to draw up the handle increases so amazingly at every enlargement of the instrument, it is necessarily inapplicable even under the most favorable circumstances to any but the most trivial purposes.

ON CASEUM AND MILK.

Two thousand five hundred parts (grammes) of the curd of new cheese, as sold in the market, were heated to 212°. For some time it contracted, and became a glutinous elastic mass, swimming in much serum. Being washed in boiling water, to remove the acid serum, and dried, it weighed 469 parts. It was a compound of caseum, with acetic and lactic acids: being divided, put into sufficient water, with 125 parts of crystallized bicarbonate of potassa, and heated, it dissolved with effervescence, producing a mucilaginous liquor, distinctly reddening litmus paper. Being evaporated carefully, with continual agitation, it left a soft portion, which, as it cooled, acquired consistency, was drawn out between the fingers into thin portions, and these dried in the air upon a sieve weighed 300 parts. This *soluble caseum* is a curcaseate of potassa, containing still butter and salts. It resembles isinglass, is of a yellow white color, translucent, and of a stale taste. It is perfectly soluble in hot or cold water, producing a fluid rendered milky by the presence of butter.

In this impure state the substance is easily prepared. Instead of the bicarbonate, the carbonate of potass, or soda of commerce, may be used. The following are hints for its application. Like gelatine it may be preserved without any alteration for any length of time, and may be obtained in enormous quantities, if required. Associated in various ways with food, it must prove of the greatest importance on board vessels for long voyages. Its aqueous solution, sugared and flavored with a little lemon peel, makes an agreeable and nourishing drink for invalids. It is a powerful cement; its solution evaporated on glass or porcelain cannot be removed without injury to the vessels; its hot concentrated solution has been applied, with great success, to join glass, porcelain, wood, and stone. The same solution forms a brilliant varnish, being applied to paper it makes labels, which, when moistened and attached, adhere with great force, &c. It is, also, a certain antidote in poison by the metallic salts.

To purify the above dissolve it in boiling water, which put in a funnel, the aperture of which is closed, and left until a layer of cream has collected on the surface. After removing this a little sulphuric acid is to be added, which will form a clot of sulphate of caseum. This is to be well washed, and then heated in water, with just enough carbonate of potass to dissolve it. The mucilaginous liquor formed is, while hot, to be mixed with its volume of alcohol. It is necessary that no deposit form at the moment; it should occur only at the end of twenty-four hours, and will include the butter, the sulphate of potass, and part of the caseum. All is to be placed on a cloth, and a clear transparent liquid will pass, which evaporated to dryness, leaves *caseum* pure. When thus obtained it resembles gum arabic.—*Ann. de Chimie*.

IMPROVED MILK.

Besides caseum and butter, milk contains salts, which are not particularly desirable. M. Braconnel took 4·4 pints of milk, heated it to 113 Fahrenheit, gradually added dilute muriatic acid, and agitated the whole. The curd formed contained the caseum and butter, and being separated from the whey was gradually mixed with seventy-seven grains of crystallized subcarbonate of soda, reduced to powder and warmed—no water was added, but the whole gradually dissolved. It had the weak acidity of recent milk, and formed about one-fifth of its bulk of cream. If formed up to its first bulk with water and a little sugar, it forms a milk more agreeable than the original, or it may be flavored, &c., and used as cream. If it be heated with about its weight of sugar it becomes remarkably fluid, and forms a perfectly homogeneous syrup of milk, which will keep for any length of time, and which by the mere addition of a sufficient quantity of water forms a perfectly white homogeneous opaque liquid, which is in every respect like sugared milk of superior quality. Carefully evaporated, (but not beyond a certain limit, or the butter would separate,) it gave when cold a soft confection, which left for a twelvemonth in a loosely-stopped bottle, underwent no change. This when exposed in small portions to the air was rendered quite dry, and could then be crushed, and kept for any length of time without change, being always reconvertible into useful states by the addition of water.—*Ann. de Chimie*.

THE ECCALEOBION.

The Eccaleobion, or "life-giving machine," forms the subject of an exhibition in Pall Mall, which, catering for our readers' information, we went the other day to inspect. We were highly delighted, not with the machine itself, for this possesses but little novelty, it being merely a cabinet of many divisions, fronted with wire and heated with hot water, conveyed in pipes; but with the intelligence and kindness of the proprietor, and with the wonderful process of incubation, or rather egg-hatching, so clearly displayed before the eyes of the visitor.

Here were eggs, transparent and fresh, next semi-opaque with life and incipient animation; further forwards chickens breaking through the walls of the shell, which had before inclosed them—some wet and weak, others, with bright eyes, and already vigorous. It was indeed a curious sight, thus to see at once, every gradation, from the newly-laid egg, to the perfect chicken rising from it, having passed through the most wonderful changes, and become a perfectly-formed and animated creature within the short space of three weeks.

Upon the table of the apartment is a good microscope, and eggs which have been broken at various periods, to show the successive changes which take place day by day.

In an impregnated egg previous to the commencement of incubation, a small spot is discernable upon the yolk, composed, apparently, of a membraneous sac, or bag, containing a fluid matter, in which swims the embryo of the future chick, and seemingly connected with other vesicles, around it. The requisite warmth, (which is about 99°,) being applied; after 12 hours the head may be discerned.

On the 2nd day—The eyes, brain, spine, and wings appear.

3rd day—The heart and its pulsation are visible.

4th day—The various parts assume a more definite shape.

5th day—The liver and the circulation of the blood are evident.

6th day—The lungs and stomach are distinguishable.

7th day—The intestines, veins, and upper mandible become visible.

8th day—The beak for the first time opens, and flesh is first formed.

9th day—The ribs and gall bladder are perceptible.

10th day—The first voluntary motion of the chick is seen.

11th day—The skull becomes cartilaginous, and feathers are evident.

12th day—The eyes and ribs become perfected.

13th day—The spleen takes its proper position in the stomach.

14th day—The lungs become inclosed within the breast.

15th, 16th, and 17th days—During these days, the infinity of pheuomenon iu this wouderful piece of vital mechanism elaborate it into more perfect form.

On the 18th day—The outward and audible reign of developed lifa is apparent, by the faint piping of the chick, being for the first time heard; afterwards on the 19th, 20th, and 21st days, it coutinually increases in size and strength, the yolk, hitherto without the body, becomes drawn up within it; then with uncommon power, for so small and frail a being, it liberates itself from its prison, in a peculiar manner, by repeated efforts made with its bill, seconded by muscular exertion with its limbs; and emerges into a new existence. The chicken at the time it breaks from the shell is heavier than the whole egg was at first.

The proprietor, in an extremely valuable pamphlet which be has published, states, that "his machiue is capable of hatching more than 100 eggs per day, at a cost of a farthing each, that poultry thus raised might be sold cheaper than butchers' meat," why, therefore, be says, "should England import from foreign countries as much as 20 tons of poultry per week, and 70 millions of eggs per year from France, when both may be had cheaper and better at our own door?" as by the adoption of his simple, but effective machine they would soon become, notwithstanding the failures which have attended former attempts at artificial incubation. We hope that all who are interested in witnessing the wonderful process, and who are not? will inspect the Eccaleobion for themselves, not merely with a view to personal gratification, but to assist by their testimony and encouragement what we have no hesitation in saying might be made a source of private and national wealth.

Such is the exhibition of the Eccaleobion, such the interesting nature of the phenomena displayed by its agency—phenomena, so magnificent and astounding—so pregnant with wonders—as to fill with admiration the profoundest philosopher, and the least contemplative of the human race; nor is it possible, that the most unintelligent Christian can survey them with indifference, or his reflections thereon not lead him

"Through Nature, up to Nature's God."

ON GRAFTING TREES, &c.

Grafting is an art in which great improvement has been made of lata years, and we are indebted to it for some of the rarest botanical delicacies we possess. It is the principal means resorted to for the improvement in quality of our fruits. The process is simple: it consists iu securing a branch, or scion, of a superior plant in juxta-position with a stock of an inferior nature, in such a manner, that in growing, they shall uuite and form one plant. But it is to be remembered that this operation must be confined to such as belong to oue genus. The ancients, indeed, in their attachment to the new discovery, entertained the enthusiastic idea that the operation might be performed indiscriminately; but experience proves how little they were informed upon the subject.

There are a few things necessary to be impressed upon the mind before proceeding with the operation. In the first place no success, I believe, has ever attended the attempt to graft endogenous plants, in consequence of the inadequate development of the essential organs. When two plants are selected bearing some anatomical and physiological similarity—such, for instance, as the shape, structure, and magnitude of the vessels, (which is only to be found in plants of the same family,) connected with a correspondence in time of the rising of the sap; and the size and strength of the respective plants being somewhat of a parallel—the scion is applied to the stock in such a manner that the vessels of the liber, or inner bark, of the two plants shall immediately correspond with each other; for it is exclusively by the union of these that the object is accomplished, and the two plants made one.

Some of your London readers may not be aware that the fruit is not changed in its *nature* by grafting; the graft and the stock invariably producing their own kind. The reason of this is, that, though the sap, after it has ascended the stock into the graft is the same, it is different in its return. The sap of each being elaborated by their respective leaves; and its conversion into cambium being accomplished, each supplies nourishment to its particular kind.

With respect to the manner of fastening the graft it should be bound round with as soft a ligature as can be procured, care being taken to prevent any extravasation of the cambium, by the application of a composition of cow-dung and clay. The period for the operation is either in the spring, while the sap is in full flow; or in the autumn, for its ascent in the subsequent spring.

T. A. P. C.

Note.—Our correspondent has used the word "cambium" with some licence. The substance called cambium is quite distinct from the sap, and is a morbid gelatinous exudation from the alburnum, or new wood, and the liber, or inner bark, given out in particular circumstances, the same as lymph from an animal wound—in the above is meant merely the descending sap. The sap in its upward flow is loaded with various salts and gases—in its passage it produces certain vegetable secretions, as resin, oil, sugar, &c.—in the leaves it receives more carbon—in its descent becomes deposited as woody fibre.—Ed.

VEGETABLE SKELETONS.

DIRECTIONS FOR PRODUCING SKELETONS OF THE LEAVES, CALYCES, AND SEED VESSELS, OR OTHER PARTS, OF PLANTS.

Procure an open-topped earthen pan, holding a gallon or more, and put into it a *quantity* of leaves, seed-vessels, &c., selected according to the subsequent directions; and pour upon them a sufficiency of *boiling* soft water to cover them. This done, place the pan upon the tiles of the roof of the house, or in any other place exposed to the warmth of a summer's sun, and the vicissitudes of the weather. Stir the leaves occasionally, (say, once or twice a week,) and carefully, but never change the water. The putrefactive fermentation will now soon ensue; and, in about six weeks or two months, according to the nature of the subjects, many of the specimens will be completely macerated: and will require no other attention than holding them singly under the

tap of the water-tub, or some other small forcing stream of water; which will wash away all the other skin and green fleshy matter. If this matter does not come off readily when assisted a little with the thumb and finger, or a small knife, the leaves must be soaked for a longer time. Those of the leaves which seem liable to break during the washing of them may be preserved from breaking by placing them upon a little piece of board, and holding them up by the thumb and finger, and, should a little of the green fleshy matter remain fixed between the interstices of the skeleton leaf, it may easily be removed by striking the leaf *perpendicularly* with a clothes brush.

They will now only require bleaching. This may be done very effectually by placing them in a band-box, with a little sulphur burning in a small vessel beside or under them. The most sure way, however, of bleaching objects of this nature is to immerse them, for a few minutes, in dilute chloride of lime, or chloride of soda.

The reason of the process of macerating directed will be readily understood by the chemist, who knows that the degree of success in the preparation of all anatomical subjects depends entirely upon the degree of putrefactive fermentation which takes place. Everything, then, which increases this fermentation, hastens the object; it will instantly be seen, therefore, why the proper time is during the summer months; and this is, also, the only time when specimens can be procured. It will be evident, also, why the water must not be changed; and why a quantity must be done at once. The object in putting boiling water, in the first instance, is to destroy vitality, and to soften, in some degree, the texture of the outer coating. Metallic vessels, especially iron ones, are very unfit to immerse any anatomical preparations in, as they communicate to the objects the dark brown stain of oxide of iron, which nothing afterwards will remove.

Choice of subjects.—Such are to be chosen as are of a fibrous woody texture; and these are to be gathered at that time of the year when the internal woody fibre is sufficiently hard, (as about June or July:) though, in the case of leaves, those of ivy and holly, may be taken all the year; and seed-vessels may be taken a little before the seed is ripe. In making your selection, carefully avoid all which are of a resinous nature, as attention to these will be but thrown away; thus the leaves of the fir tribe, the camphor tree, the laurel, the bay, and of most of the evergreen shrubs and trees, are inapplicable. This advice will apply, with still stronger force, to the astringent kinds; it is in vain to try the leaves of the oak, chesnut, maple, elm, willow, hornbeam, sycamore, tea, buckthorn, walnut, hazel, and many others; as the leaves of all these contain much tannin, which not only renders them imperishable, but, by contaminating the water, prevents the decomposition of the other leaves under maceration with them.

Proper and easy subjects.—Leaves of the white poplar, black poplar. Lombardy poplar, apricot, apple, orange, lemon, box, ivy, holly, many of the exotic passion flowers; Magnolia glauca, acuminata, and others; lime tree, tulip tree. Calyces of Moluccella lævis, which are, when prepared, very beautiful; also the calyces and seed-vessels of Nicandra physalodes, of the winter cherry, (Physalis Alkekengi,) of henbane (Hyoscyamus niger;) of all the campanulas, particularly Campanula Media, (Canterbury bell,) C. Rotundifolia (the harebell,) and C. Trachelium; the larger mallows, the tree mallow, (Lavatera arborea,) horehound, (Marrubium album;) Eryngium Andersoni, alpinum, campestre, and maritimum; Medicago falcata and arborea; Stachys sylvatica, several of the nettles, Galeopsis Ladanum, Dictamnus albus, Phlomis fructicosa, Datura Stramonium, Atropa belladona, the scutellarias, and the capsules of all the species of poppy. To these may be added the stalks of cabbage, radish, flax, hemp, and stinging nettles; the tuber of the turnip; the involucres of Astrantia major and Austriaca, and of the Hydrangea hortensis and herbacea.

ON SACCHARIZING THE FECULA OF POTATOES.

BY M. DUBRUNFAUT.

(*Read before the Royal Society of Agriculture.*)

The author commences his memoir by considering the very great utility of combining manufactures with agriculture, at least within certain limits. He thinks that, in carrying on the manufacture of sugar from beets on the large scale, where the great residua is employed merely for feeding of cattle, it would be advantageous to make a more valuable use of it, even if the quantity of sugar imported from the colonies should, in consequence, experience a considerable diminution; and, also, that the manufactory of starch, the extraction of fecula from potatoes, of oil from seeds, and the manufacture of beer, are arts which the intelligent cultivator of the soil ought to practise, as they may all be conducted at a very trifling expense.

Passing on to the process of distilling from the fecula of potatoes, he brings forward a series of experiments; by which he proves, that the operation well known in distilleries by the name of *maceration*, or steeping, is the most important, as it conduces to saccharize the barley. Wishing to ascertain exactly the action which is exercised on other vegetable matters, in the state of fecula, when treated by maceration, he mixed 500 grammes of the fecula of potatoes with an equal weight of cold water; to which he gradually added 5500 more of boiling water; when the whole mass formed a very homogeneous paste, at the temperature of 508 of Reaumur—1248 of Fahrenheit. In this state he added to it 150 grammes of ground barley-malt, and stirred the whole well together for some minutes, in order to mix it thoroughly: he then left it at rest, in a stove heated to 508 Reaumur. After some time, the mass, which was at first solid and thick, was completely liquified, its taste changed, and it had become saccharine; on being submitted to the alcoholic fermentation, with a little ale-yeast, previously added, it yielded on distillation 38 centimetres of excellent brandy, at 19*s*. M. Dubrunfaut, thus decidedly ascertained the property possessed by the malted-barley, of rendering the fecula fluid, and saccharine, in the space of an hour.

Still, with a view of applying these principles in rural economy, the author extended his researches to the more simple and least expensive methods of employing them; and, in the end, he effected the separation of the fecula from potatoes, in a more convenient manner. The potatoes being rasped or grated very fine, 400 grammes of the pulp are thrown into a brewing-tub with a double bottom; and, whilst the workmen stir and agitate it with rakes as much as possible, boiling water is poured upon it, and all the fecula is then converted into a paste. Twenty killogrammes of finely ground malt are

then added, and a small quantity of short wheaten straw may also be added with edvantage. The whole becomes fluid and saccharine in the space of two hours.

The liquid is now drawn off, as in brewing, and conveyed to the fermenting tub; the remaining mass of pulp is then left to drain for some time, when e fresh quantity of water at 50° of Reaumur is added, and tha whole agitated as before. The liquor is then drawn off, and the pulp submitted to the action of a cylindrical press. In this manner the greetest quantity of fermentable matter is extracted from the potatoes; the liquid is not accompanied with any deposit injurious to the distillation; and fifty-four litres of brandy, at 19° of an excellent taste, may be drawn off from it. The residium may be eaten by animals. The experiment proves, that by means of this change in the process, the product of brandy is greater, and it possesses a more agreeable flavor than when the potatoes are reduced to pulp by means of steam and agitation.

The matter introduced into the alembic is perfectly fluid; and therefore presents no difficulty in distilling it: the manipulations are not more expensive, nor more complicated; and they may be effected by the common epparatus, which is a very greet advantage.

M. Dubrunfaut does not confine his researches merely to the best moda of saccharizing the fecula of potatoes; but he wishes to apply them to various other arts; that of brewing has not escaped his investigation. After heving treated the fecula as before stated he added hops to it, and concentrated the whole to 6 of the crometer; he then submitted the liquor to fermentation; which, when terminated, a most agreeable and vinous odour exhaled from it: after some days, it was put into bottles, when it terminated well, and greatly resembled Paris beer. By fermenting the liquid without the addition of hops, and substituting the honey of Brittany in place of them, he obtained a beer which had the taste and all the quality of the beer of Louvaine. But it is now particularly in the manufacturing of an economical hear, which is so useful to the numerous class of workmen employed in agriculture, that this invention is most valuable; for tha potatoes and the barley used in this manufacture may be obtained everywhere; they are neither dear nor unwholesome; and it is not requisite to make e perfect beer of them, but merely to produce a light and refreshing drink which neither requires boiling nor concentrations. In order to do this, the liquid produced by the maceration may be diluted with a quantity of water, which may vary according to the alcoholic strength we wish to give to the liquor: and which may then be fermented with a littla yeast, or even with baker's leaven.

TERMS AND MATERIALS OF ART.

(*Resumed from page 14.*)

Breadth of Light.—That part of a picture most brilliantly colored, or where the greatest portion of light is seen to fall. In historical pictures the greatest breadth of light should fall upon the chief characters. We see this perticularly in "West's Death on the Pala Horse," "Martin's Belshazzar's Feast," "Tha Cartoon of St. Paul Preaching at Athens," &c., so that the eya is bound not merely by perspective but light to rest upon a particular part of the picture.

Subordinate Lights. — Portions of the picture colored more or less brilliantly in different parts from tha breadth of light, as when e moonlight landscape, besides the breadth of light reflected from the lake, is also reflected from a cascade or a rivulet.

Catching Lights.—The edges or small parts of objects touched with brilliant colors, to bring them out in relief, such as the moonlight-edged cloud so prettily described in Milton's Comus:—

> Was I deceived? or did a sable cloud,
> Turn forth her silver lining on the night.

Reflected Lights.—Lights which fall on the shaded sides of objects, by being reflected from water or the like. It also signifies the increased brilliancy and change of color given by a particular luminous object; thus in a sunset view, the clouds and particular objects will become tinged with a color not natural to them. The rainbow too is a reflected light.

Conflicting Lights.—Are seen when an object is illumined by two lights et once, as of the sun and a conflagration, and a torch-bearing procession by moonlight. Conflicting lights are extremely difficult for the painter to manage, on account chiefly of tha shadows; he is, therefore, apt to make one intense, and to take his breadth of light from that, and to subdue the other, by placing it at a distance or in a gloomy part of the picture, that in the latter case contrast may add to its effect. In most of the pictures of "The Netivity," "Tha Adoration of the Shepherds," &c., there are conflicting lights: the divine emanation from the head of the infant Saviour, and the diffused light of the rising sun, and there is often great skill manifested that thesa lights do not interfere with each other.

Half Tint.—Is the medium between light and shade.

Tint.—Every gradation of color, from its most perfect or intense state till it imperceptibly passes into white.

Local Tint.—The color of any object in a picture, when nothing interferes to affect its brightness. The terms, tint, half tint, and local tint, are more commonly applied to water-color drawings, than to those in oil, because in the latter, white is added to produce the requisite color; in the other process, the color of the paper lends its aid, as the colors are only *washes* and the paper assists in producing the requisite tint; thus, in water-color drawing it is usual to direct that such and such color should be *washed* in.

Neutral Tints.—Grey is termed, by way of eminence, the neutral tint, being the mean between black and white. It is made by mixing together a transparent red, blue, and yellow; or else eithar two of the secondary colors, such as orange and green, purple and green, &c.

Mass.—A large proportionate quantity of anything in a picture, whether of light, shade, or objects—as a mass of sunshine, a mass of trees, e mass of architecture, a mass of warm and cold colors, &c.

Warm Colors.—Those in which red or yellow tints appear.

Cold Colors.—Those in which blue or green predominate.

Shade.—That part opposed to the light.

Shadow.—Is the obscuration of light by an interposing object. Shade and shadow are by no means to be confounded. In a dungeon, all is in shade, but there may be no shadow—a bandit may lurk in the shade and be careful to cast no shadow; it is in the brightness of the day when shadows are most conspicuous, in the shade of night they are lost in gloom.

Keeping.—In drawing, is the preservation of requisite light and shade, according to distance.

Hue.—By this is meant any componod color undiluted.

Harmony.—That peculiar arrangement of lines, lights, shade, and color, which shall be most conducive to beauty of effect.

Effect.—The influence prodnced on observers, by the result of the combination of subjects and execution in a picture.

Tone.—The general effect or appearance of the coloring, as inflοenced by warm or cold colors.

Spottiness.—A part or parts, either of light or of dark, too conspicuous to agree with the situation in the scene. The correction of such spottiness is necessary to the preservation of keeping.

Contrast.—Opposition of any two things as to character, whether it be in lines, lights, shade, or color. The due managemeot of contrast is worthy of the artist's most attentive study, and a capability of producing harmonioos contrast should be his highest endeavoor. In nature we see this everywhere around. The cool blue sky forms an harmonious contrast with the brilliant orbs of heaven, and the bright and warm tints of the sun-lit clouds. The brown earth forms a fine contrast with the purple heather, the green mantle of herbage, and the sylvan canopy around—while the cool and refreshing grass sets off to double advantage the flowerets, which nestle their round, bright, and glowing heads beneath its long and spear-shaped leaves.

(Continued on page 257.)

PERMANENT BLACK CLOTH.

As black is a color now in such general wear, both for morning and evening coats, and as there is a very great difference in the quality of this color, according to the process made use of in dyeing it, it may perhaps be useful to know how to distinguish permanent genuioe colors, dyed in the wool, from false or spurious ones dyed in the piece—the former having received a ground or preparation of indigo blue, which is a fast and permanent dye, and can alone insure a sound color—the latter, or piece-dyed color, being almost entirely composed of logwood, combined with the sulphates of iron and copper, and is a false and fugitive shade—in fact, merely a stain upon the cloth.

The Test.—Put about a tea spoonful of oxalic acid into a small phial, and add as much woter as will dissolve it; shake the mixture till the crystals disappear; then moisten the cork three or four times with the acid solntion, and press it smartly upon the cloth to be examined; in a few minutes a spot will appear upon the part the cork has pressed, which, if indigo has been used as a base or groood to the color, will be of a greenish olive shade; but if no indigo has been employed, and the color is composed wholly of logwood, and the sulphates of iron and copper, the spot will change to a dusky orange, or fawn color; and a black so dyed will fade on a few weeks' exposure to the sun and air, and turn to a dingy slate color. The wool-dyed black, upon an indigo gronnd of proper depth, improves by wear and exposure to oxygen, and preserves a good full shade till the cloth is eotirely worn out. This has been proved by experience. Many other acids will produce similar effects in detecting false colors, but the oxalic is preferable, being the most easy and quickest in operation.

The above test will do for many other colors, as well as black, and will show where indigo has been used by the greenness of the spot. The depth of blue given to a color, will be seen by the darkness that remains after the acid has been applied.

MISCELLANIES.

Resin of Benzoin.—M. Berzellus has asserted that the resin of benzoin, on distillation, furnishes an oil, which, like that of bitter almonds, is by long contact with the air converted into benzoic acid. Since then M. Freney has shown that this oil is changed into benzoic acid under the influence of potass. M. Auguste Catrours, has been making further experiments, with the following results: in a pure state, this oil is limpid, colorless, a little soluble in water, to which it communicates its odour and its flavor; it is solnble in alcohol and ether in every proportion: its odour is sweet and aromatic; its flavor acrid and burning; its specific gravity greater than that of water, and it boils at about 205°.

Artificial Granite Roads.—Since Wednesday week last, a number of workmen have been employed in laying down a new pathway in that part of the New Bird Cage Walk, near Storey's Gate. The process adopted in the laying it down is similar to that of the asphalte, the composition being poured out boiling hot upon the loose gravel with which it amalgamates; a few minutes suffice to make it quite cold, and as hard as the hardest stone. The appearance of that part of the pathway already finished is that of a finely polished and black block of marble. It is said to be impervions to wet, will not be affected by the sun, and its durability is even greater than that of marble itself which has been prooved from the fact, that a rough piece of marble or granite can be rubbed perfectly smooth on a block of this composition without apparently wearing the latter. Its hardness may be proved from the following fact, that a block about 5-feet by 3, and 2 inches in thickness, was struck for several minutes with heavy sledge hammers by the workmen, and it failed to break, whereas, marble, granite, or any other stone would have flown to pieces. This composition is the invention of M. d'Harconrt, a French gentleman, who is laying down the above-mentioned pathway by order of the Commissioners of Woods and Forests, who intend, should the experiment succeed, to have the whole length of Bird Cage Walk done in a similar manner, as also the parade in front of the New Palace.

Fossil Woods.—To prepare Sections for the Microscope.—A thin slice is first cut from the fossil wood by the usual process of the lapidary. One surface is ground perfectly flat and polished, and then cemented to a piece of plate glass by means of Canada balsam. The slice thus firmly attached to the glass is now ground down to the requisite degree of tenacity, so as to permit its structure to be seen by the aid of the microscope. It is by this ingenious process that the intricate structure of any fossil plant can now be investigated, and the nature of the original determined, with as moch accuracy as if it were now living.—*Mantell's Geology.*

Sewing on Glazed Calico.—By passing a cake of white soap a few times over a piece of glazed calico, or any other stiffened material, the needle will penetrate with as much facility as it will through any other kind of work. The patronesses of the School of Industry pronounce this to be a fact worth knowing, the destruction of needles in the ordinary way occasioning both loss of time and expense.

Seed-down of Typha for Stuffing Bedding for the Poor.—When tha seeds are ripe, they fall in great wool-flocks from the stalk; and as Typha grows wild in many places, they could be procured In abundance. When beaten for somo timo, they separate, and open all their balloons, so as to becomo as soft and elastic as feathers; and, from their hygrometric expansibility and contractiveness, they would never get into clots or lumps if sewed up into a bag or bed-tick.—*Gardener's Magazine.*

ANSWERS TO QUERIES.

1—*Why does a cat always fall upon her feet?* Every animal, when falling, endeavours to save itself. A man, falling forward, instinctively throws ont nis arms. Animals, with heavy bodies, usually fall on their hind-quarters, hnt those of the cat kind, having Immense muscular power, are ahlo to turn themselves round, so as to bring their feet heneath them; while the shock of falling, which would dislocate the limbs of most other creatures, leaves them uninjnred, on account of the little woight of their bodies, springiness of muscles, and strength of tendons.

7—*What occasions the luminosity of the ocean?* Undouhtedly electricity, not, perhaps, elicited either by chemical action, nor yet friction of inorganic matters, hut from tbo lnminous property, whlch is so apparent in certain putrescent animal and vegetable substances; or in otber cases from myriads of phosphorescent animalcules—the ligbt of which is by the microscope proved to he analogous to the electric fluid: not only is this the case witb these minnte Insects, but with others of larger size and more complicated structure—for example, if the glow-worm be examined by this instrument, its ligbt will be seen passing from the animal like tbousands of electric sparks.

11—*How is aromatic vinegar made?* Put into a retort ahont half an ounce of acetate of lead, or acetate of copper, witb two or three cloves, and a few grains of campbor. Unite the retort to a receiver, distil the above, and the prodnct will he aromatic vinegar.—TOPHAM'S CHEMISTRY.

13—*Has thunder any effect upon beer, milk, &c.?* Nono whatever; hut that still, warm, and what is commonly called muggy stats of tbe air, whicb so frequently precedes and accompsnies thunder storms, is likely to occasion a second fermentation in beer, which has not heen tboronghly cleansed in the first instance, as well as to throw that, at the time fermenting, into more rapid action. Milk, also, in weather like this, is more than nsually apt to run into the scetous fermentation. Putting a piece of iron upon a cask to preserve the contents from tbe effects of thunder is a useless and ridiculous practice.—ED.

The effect of tbnnder on heer is proauced by the inflnence of the disturbed electric fluid in the atmosphere. Beer, milk, &c., are decomposed by it.—W. BASTICK.

14—*Do vegetables generate earth?* If hy generate be meant create, certainly they do not—"Ex nihilo nihil fit." Bnt taking this verb to signify forming, we answer they do. A moss growing on a wall forms, by its decay, earth; and in a similar manner is formed under our daily observation tho black mould, which covors the surface of tbe gronnd, and which is thickest whore vegetation is most luxuriant. A grain of wheat growing in a glass case, and with nothing but water to support it, produces stems and leaves covered with flint; and the Equiseta, or Horse-tails, a still greater quantity.—The Chara plants, so common in ditches, rivers, &c., do, under the same circumstances, no less than, in their natural situations, generate lime. Peat and coal are wholly of vegetable origin.

15—*Is color a property of matter, or of the mind?* Color is caused hy the property bodies have of absorbing soma, and reflecting othors, of the colored rays which form tho prismatio spectrum. It is, therefore, essentially the property of matter.—W. BASTICK.

16—*It is said that wheat will not flourish near a barberry bush. Is this a fact? If it be, by what author is it mentioned, and what is the reason of it?* It is a general opinion, both in England and France, that this is the case, though there ls mucb doubt among botanists and farmers of the sonndness of it. Dr. Withering, in his "Arrangement of British Plants," says thns:—"This shrub should never bo permitted to grow in corn lands, for the ears of wheat that grow near it never fill, and its influence in this respect has been known to extend 3 or 400 yards across a field." This does not agree with onr own observatlons, never before having observed any such an effect.

18—*Is light a substance or a force?* Somo philosophers regard light as consisting of particles of inconceivable minnteness, emitted in succession by luminous hodies. Others conceive that it consists in certain nudulations, commnnlcated by luminons hodies to an etherial fluid which fills all space. If this latter theory be correct, and it is generally supposed to be so by scientific men, light may bo considered as a *force.* If the former is tha true one it must be regarded as matter.—BASTICK.

19—*How deep does light penetrate into the ocean, and what becomes of it when it can get no lower?* The rays of light in passing through the ocean becomes gradually absorbed, whicb commences the moment they come in contact with it, consequently darkness is in the same ratio as the degree of absorption. From these facts it is evident tbat total darkness pervades the ocean after a certain depth. When it is not of adequate depth to absorb all the rays they become reflected.

20—*Is there, in any museum, a toad which has been embedded in stone, and also the stone which surrounded it.* A correspondent informs us that such a toad is in the museum at Edinburgh; and In "Johnson's Travels in Europe" one is said to be at Cracow, in Poland.

27—*Why does a fine needle float upon the water?* Because of tbe repulsion wbich there is between the polisbed steel and tho water, a channel is formed around the needle, and tbus it floats, or ls horne in a *boat of air.*

28—*Why does the wick of a floating chamber lamp always go to the side of the vessel of oil in which it burns?* The flame heats a small part of the oil, whicb consequently expands, and, by tho decrease of its specific gravity, must be pressed npwards by a force sufficient to raise part of it abovo the general level; bnt this portion of oil in its endeavonr to ascend, meets with a resistance from tho weight of the incumbent lamp, which will determine it, ln seeking a vent, to slide from nnder the lamp in a thin superficial stream. The re-action of this stream of rarefied air or oil, thns issuing most rapidly and copiously from a particular side of the hase of the lamp, must impel it in a contrary direction.

THE ELECTRIC KITE.

ELECTRICITY.

(Resumed from page 44.)

In the early stage of electrical science, little more than a few trivial experiments were known, and then but imperfectly understood; but when the electric light had been seen—the noise of the spark heard—and still more when electricians, by the discovery of the Leyden phial, were enabled to operate with accumulated electricity, its analogy with lightning was soon suspected, though means did not at first offer themselves to prove experimentally that the two fluids were identical. It remained for the comprehensive mind of Dr. Franklin, not merely to suggest means of proof, but to carry those means into the most successful operation. He imagined the nature of the fluids to be identical, by the similar marked appearance of the spark given off by the machine, and the zigzag flash of lightning; also by the same effect that each has on animal life—in melting metals—disturbing the power of magnets—and rending to pieces such imperfect conductors as they may have to pass through.

The first method which offered itself to his notice was raising in the atmosphere lofty metallic rods; and as a spire of very considerable altitude was, at that time, erecting in Philadelphia, he was waiting with some impatience its completion; when he thought that if a metallic pointed rod was attached to a kite, it would be an effectual conductor from the clouds to the earth. He, therefore, after preparing a large silk handkerchief, took the opportunity of the first approaching thunder-storm, and went into a field where there was a shed proper for his purpose. But dreading the ridicule which he feared might attend an unsuccessful attempt, he communicated his intention to no one but his son, who assisted him in flying his kite. The kite was raised—a considerable time passed without appearance of success, when, just as he was beginning to despair, he observed some loose threads upon the string of the kite begin to diverge and stand erect. On this he fastened a key to the string, and on presenting his knuckle to it, was gratified by the first electric spark that had thus been drawn from the clouds: others succeeded, and when the string had become tolerably wet by the falling rain, a copious stream of the electric fire passed from the conductor to his hand—a large quantity was collected—and in the shed he performed with it all the experiments then known.

These interesting experiments were, of course, repeated in almost every civilized country with variable success. In France, a grand result was obtained by M. Romas, who constructed a kite, 7 feet high, which he raised to a height of 540 feet, by a string having a fine wire interwoven through its whole length.

Believing that some of our readers may wish to know somewhat more of this apparatus, and to perform the experiments adapted to it with certainty of success, and, at the same time, perfect safety to themselves, we have prepared the introductory engraving, and the following description of

THE ELECTRIC KITE.

Tie together in the form of a cross two canes, or still better two rods of deal, about three feet long each. To the four corners of the cross-sticks fasten the corners of a large silk handkerchief; a loop must be made by piercing a hole in two parts of the handkerchief, and a string fastened to one of the sticks, in the manner of the loop of a boy's kite; indeed a common kite will answer the purpose quite as well as one of silk, except that if it is to be used in stormy weather, the latter will by wet soon become spoiled. The size also is of very little consequence, except that the larger the kite the higher it will usually ascend, and therefore for this cause, and this alone, a large kite is most effective. The kite itself being formed, and having a common kite tail attached to it, or else long strips of calico sewed together, which will be found more convenient; it must be furnished with two or three pointed thin copper wires fastened to the loop, extending upwards a few inches above that part of the kite which flies highest, and projecting from each other, as seen in our figure.

The string is the next object of importance, that evidently is the best which has a fine wire or two passing down it. Most persons desiring this string, have taken the trouble to wind the wire around the whole length of string previously bought, not knowing that were they to take the fine wire to any string spinner, he would weave it up along with the hemp at once, putting a wire into each strand, if required, and at the expense of a mere trifle additional. Supposing a person should be in such circumstances or situation that this string cannot very easily be procured, the best substitute for the wire will be found in soaking a common string in salt and water for an hour or two previous to using it. It will thus imbibe sufficient moisture to render it a good conductor, even in a very dry atmosphere, where string wetted with water only would become useless. The upper part of the string must be carefully connected with the pointed wire carried above the loop.

The lightning, or electric fluid, being thus attracted at the kite, and led downwards by the string, it must be retained from passing silently to the earth beneath. For this it will be necessary that the lower end of the string be attached to a cord of silk, about three feet long, to be kept quite dry, and for convenience of operating, a large key is usually tied at that part where the string and silk are united. The kite being raised, the electric fluid will pass down to the key; here being stopped by the silk cord, will be given off in sparks or flashes, more or less powerful in accordance with the quantity of lightning which may be in the air. The operator may easily conduct it elsewhere, or charge his conductors or batteries without difficulty.

No philosophical instrument is more simple in form and easy to construct than the electric kite, yet no one needs more care in its management. To fly it when a thunder storm is approaching would be attended with the greatest* danger, unless every precaution be taken. In this state of the atmosphere the raising and lowering of the kite requires the utmost circumspection; to let the string wind out immediately from a ball in the hand, making thereby the body a *part of the conductor is too venturesome*, the string should pass over and touch an iron railing, or through a ring fastened to a metal rod driven deeply into the ground, whilst the person who holds it is placed upon a dry glass-legged stool, or otherwise insulated; as, for example, upon a pile of books, or paper. When up a sufficient height, the remainder of the string may be fastened to the key, and the operator able to remove himself to a safe distance. It is advisable also that the electric fluid should never be introduced into a dwelling house, for a thunder storm is a terrific agent to tamper with, and once invited into our houses, may occasion dreadful damage, ere it be allayed. We have seen flashes of four or five feet in length, and once when we left our kite up during a stormy night, the key appended to it seemed as it were a ball of fire, illuminating all around, and the very kite and string appeared as if enveloped in lambent flames.

Fortunately, to operate in weather like this is not necessary. The calmest and brightest evenings of summer; the densest fogs of autumn; and the clearest frosts of winter, yield mostly as much fluid, as is convenient to use; in either time *small* sparks will be visible, and may be felt by a knuckle presented to them, when they will be found very different from those usually afforded by the electrical machine. The air will be found *positively* electrified ninety-nine times out of each hundred, yet the sparks as given by the kite string will be red, comparatively short, make but little noise, and be felt so much more pungent when passing to the hand, that they rather resemble the *vibration*, or small shock, than that known as the electric spark.

Note.—To ascertain whether the atmosphere be charged positively or negatively, charge a Leyden jar, (holding about a pint) with the fluid collected, and discharge it by a helix or open coil of wire, which has within it a sewing needle wrapped in paper. If the air be positively electrified, that end of the needle held nearest the inner coating of the jar will be found a north pole—if the air be negative it will be a south pole.

(*Continued on page* 84.)

PHOTOGENIC DRAWING.

The periodicals still teem with fresh experiments and receipts relative to this art: we are therefore induced to give the following succinct observations and memoranda, not only to answer numerous queries submitted to us upon the subject, but in hopes of aiding and directing our readers somewhat more in the process; and, first, we admit ourselves wrong in recommending bibulous papers (such as blotting paper) as we have found, by subsequent experiments, that it is not so sensitive as other kinds.

Papers.—That sort of paper called "double small hand" is recommended as being well adapted for the intended purpose; being sponged it seems to be equally moistened in every part, and also when finished void of spottiness. It is, however, not of a smooth surface.

Printing papers answer very well, particularly the thin kinds. In the thicker printing papers, the plaster of Paris added to increase their thickness and weight absorbs unequally the solutions.

The highly glazed writing papers produce a uniform color, and the finer and more highly glazed the paper is, the better will it suit for photogenic purposes. These will be found advantageous, not

only from possessing a firm texture and regular color, but also from the smaller quantity of the solution of nitrate of silver being necessary, it not penetrating into their substance.

Solutions.—1st. A nearly saturated solution of chlorine—dry and wash afterwards with nitrate of silver. This is not very sensitive; it becomes of a fine brown color, which is but slightly altered by the stopping agents. It is adapted particularly to highly-glazed papers.

2nd. Wash the paper with ammonia and nitrate of silver. Is not very delicate, but easily made.

3rd. Chloride of soda, twelve grains to one oz. of water, and nitrate of silver. It must not be used with absorbent papers, but with the highly-glazed kinds. It is very delicate and sensitive to light.

4th. Chloride of lime, twelve grains to one ounce of water, and nitrate of silver afterwards—applicable to any paper.

5th. Wash first with ten grains of salt, and twelve of chloride of lime, mixed together, and dissolved in an ounce of water. This forms a very excellent paper, and answers best with the camera obscura.

6th. Dilute muriatic acid, twenty-four drops, (S. G. 1-12,) to an ounce of water, and nitrate of silver. This forms a delicate paper, whether of the glazed or the absorbent kind—for the latter it should not be above half this strength.

7th. Common salt, ten grains to an ounce of water, and nitrate of silver afterwards.

Muriatic acid and the chlorides of metals, as common salt, require more care in their proportions than the foregoing substances; and an experiment which was tried, shows the absolute necessity of using an excess of nitrate of silver.

A weak solution of nitrate of silver, (twenty grains to the ounce,) was treated with excess of chloride of sodium, when an insoluble chloride was precipitated; this was exposed to the direct rays of the sun, without the slightest change; the supernatant liquor was then poured off, and the precipitate well washed two or three times with distilled water, to remove any superfluous salt which might perchance be present; the chloride of silver was again exposed to the light for many hours, when only a slight brown tint was produced. On the contrary, when the nitrate of silver was treated with such small quantities of salt, that part of the solution of silver remained in excess, the light speedily blackened the chloride exposed to its action. * * * Similar experiments were tried with chlorine, chloride of lime, and chloride of soda, when excess did not prevent the blackening; but when muriatic acid was used the same phenomenon was observed. * * * Without endeavouring to explain the difference of the action of light under these different circumstances, an important practical inference is to be drawn from them; for if any circumstance prevents the nitrate of silver being in excess, no action will be produced.

In all the above it is to be supposed that the strength of the solution of nitrate of silver has been fifty grains to the ounce of water.

Fixing.—1st. Dilute muriatic acid, about twenty-four drops to the ounce of water. It is not much to be depended upon.

Two ounces of common salt to a pint of water fixes very dark drawings, but those of a lighter tint become altered to a yellowish brown. This is corrected by the addition of a little sesquichloride of iron, which communicates a pink tinge. Ten grains of hydriodate of potass to an ounce of water; this turns the white parts to a pale yellow.

Solution of iodic acid, fifteen or twenty grains to the ounce, is very excellent for stopping, particularly applicable to delicate drawings of feathers, or other delicate delineations, when it is desirable that they should not long remain in the light. By this the white parts do not change to any other color.

Should it from any cause be thought desirable to remove from the paper the color which it acquired by light, this may be performed either by a strong solution of corrosive sublimate, which will render the paper quite white, or by a strong solution of hydriodate of potash, which gives it a yellow tint. If to the saturated solution of corrosive sublimate a little gum be added, it may be used with a quill pen, either to prevent the action of light, or to make white lines or marks after the action of the solar rays. Drawings may be made with great effect in this way, on paper previously exposed to the sun; and this is by far the best mode of proceeding, when naturalists or any other persons are desirous of circulating a few copies of any delineation among their own friends; for as the white parts are exceedingly diaphanous and the black impervious to light, the drawings made by this means are much more distinct than those made by the ordinary described processes. This mode will be found exceedingly valuable where a few copies of any drawing of machinery are suddenly wanted for estimates of prices or other causes; and the strongest light will never affect the original drawing.

By the common method of making photogenic drawings, should any be imperfect or otherwise damaged, it will be better to expose them freely to the action of the sun; by which means a uniform black ground will be produced, which will be suitable to the use of the corrosive sublimate: and thus any waste will be prevented. A thin paper, which should be slightly moistened before use, is most applicable to this mode of drawing. The photogenic paper may be blackened either by dilute solution of proto-sulphate of iron or by hydro-sulphate of ammonia.

Photogenic drawings that are produced by the direct influence of the sun, copies of prints, impressions of plants, feathers, &c., must be in the exact size of the original; those taken by the microscope may be made of any moderate size; those by the camera obscura, of necessity must be very small; in fact, as it has been well observed "its use in this last department will for ever be limited, for a portion of an object only can be represented accurately; as, for every distance, the camera requires a different adjustment of its focus, so that to take a landscape a hundred different foci would scarce suffice. For this reason, it certainly appears that the results of M. Daguerre's experiments must be exaggerated."

In taking a photogenic drawing from a print, it is better to put the *face* of the print upon the prepared paper, but this is not absolutely necessary; in our drawings on page 33 the print was placed face upwards, thus although there is an alteration of shadows, there is no reverse of position; the right hand of the view is still the right hand of the copy. In taking a second transfer, in order to obtain a fac-simile of the original, much effect is lost by the cloudiness inseparable from the process; to remedy this, Mr. Galpin, of the Adelaide Gallery, augments the shadows and brightens the lights of the first process, before he proceeds to submit the copy to a second: by which judicious means a much more spirited delineation is produced.

A claim has lately been set up by the Italians for the discovery of M. Dagnerre's process, stating that they were acquainted with it as early as 1686.

CLIMATE, SEASONS, AND PERIODS OF TIME, INDICATED BY FOSSIL WOOD.

By knowledge of comparative anatomy, the forms, structure, and economy of beings long since obliterated from the face of the earth, may with certainty be determined. So by the aid derived from a few botanical principles we may illustrate not only the form and character of vegetables, of which but the faintest vestiges remain, but also point out the important inferences at which we may arrive, relating to the state of the earth, the nature of the climate, and even of the seasons which prevailed at the periods when those plants flourished. Our distinguished countryman, Professor Babbage, has forcibly exemplified the inductive process by which such results may be obtained.

"We have seen," observes this distinguished philosopher, "that dicotyledonous trees increase in size by the deposition of an additional layer annually between the wood and the bark; and that a transverse section of such trees presents the appearance of a series of nearly concentric, irregular rings, the number of which indicates the age of the tree. The relative thickness of these annular markings depends on the more or less flourishing state of the plant during the years in which they were formed. Each ring may, in some trees, be observed to be subdivided into others, thus indicating successive periods of the same year during which its vegetation was advanced or checked. These rings are disturbed in certain parts by irregularities resulting from branches; and the year in which each branch first sprang from the parent stock, may therefore be ascertained by proper sections. These prominent effects are obvious to our senses; but every shower that falls, every change of temperature that occurs, and every wind that blows, leaves on the vegetable world the traces of its passage; slight indeed, and imperceptible perhaps to us, but not the less permanently recorded in the depths of those woody fabrics.

"All these indications of the growth of the living tree are preserved in the fossil trunk, and with them also frequently the history of its partial decay. Let us now examine the use we can make of these details relative to individual trees, when considering forests submerged by seas, imbedded in peat mosses, or transformed, as in some of the harder strata, into stone. Let us imagine that we possessed sections of the trunks of a considerable number of trees, such as those occurring in the Island of Portland. If we were to select a number of trees of about the same size, we should probably find many of them to have been contemporaries. This fact would be rendered probable if we observed, as we doubtless should do, on examining the annual rings, that some of them, conspicuous for their size, occurred at the same distances of years in several trees. If, for example, we found on several trees, a remarkably large annual ring, followed at a distance of seven years by a remarkably thin ring; and this again, after two years, followed by another large ring, we should reasonably infer from these trees, that seven years after a season highly favorable to their growth, there had occurred a season highly unfavorable to them: and after that two more years, another very favorable season had happened, and that all the trees so observed had existed at the same period of time. The nature of the season, whether hot or cold, wet or dry, would be known with some degree of probability, from the class of tree under examination. This kind of evidence, though slight at first, receives additional and great confirmation by the discovery of every new ring which supports it; and, by a considerable concurrence of such observations, the succession of seasons might be ascertained in geological periods, however remote."

WAXEN FRUIT.

(Resumed from page 23, and concluded.)

The requisite mould being prepared as before described, it will be necessary to have in readiness for casting several small pipkins, some white wax or spermaceti, a hand-basin of cold water, and the following colors:—The palest chrome yellow, Prussian blue, burnt umber, red lead, flake white, and lake, all in powder, or still better, ground up with oil, as used for painting.

The process of casting all of larger fruits is the same; having therefore previously spoken particularly of the apple, we will illustrate the method by that fruit; a mould of one of which in two parts we are presumed to have ready. Place some of the wax upon a small fire to melt slowly; when melted, add a little chrome yellow, and if you please to have a green apple, a very little Prussian blue along with it. While this is going on, the mould should be soaking in the basin of water. When the wax is ready, take the mould out of the water, and wipe the inside of it dry with a cloth. Then pour the melted wax into it, holding one half of the mould in the hand until it is nearly full; put the other half mould over it in its exact position; which will be indicated by the various notches or holes cut in the sides. This done, hold the two parts tightly together by the hands, and without loosening them in the grasp, turn them over and over, until the melted wax within has spread itself on every part of the inside of the mould. Thus continue it in motion until the wax is completely set or congealed, which will be after a minute or two, and which may be known to be the case, when, by shaking the mould, no noise of a liquid is heard within. When thus partly hardened it must be placed for some minutes in a basin of cold water, when most probably the mould will separate of itself; if it does not, the least trouble will be sufficient to remove it from the apple withinside, which as to its casting is now complete, and of course will be found more or less hollow in proportion to the quantity of wax employed.

In making large fruit, the hot air within the mould, having no vent, will sometimes make the wax spurt from the joint; this is to be avoided by holding the filled mould upright a few seconds before turning it about. The edge around the cast fruit where the two sides of the mould joined must be pared off carefully with a knife. Nothing beyond the above, except as to variation of color, is requisite in casting oranges—lemons—eggs—yellow plums—walnuts—pea pods—capsicums, or any other uncolored object, (miniature busts and wax dolls are colored with flake white and lake, they are also much better if a little Canada balsam be mixed with the wax;) but if the fruit be partly colored, much care in after painting is requisite.

Supposing a red blush be wanted on the apple, a little dry lake is taken up by a bit of flannel and rubbed evenly on the side of the fruit; if a streaked

apple be wanted, mix a little lake with spirits of turpentine, then, taking a small quantity in a short haired stiff brush, jerk it out of the brush on to the fruit, when it will run down the sides and produce the effect. If any peculiar marks or spots are to be imitated, they may be painted with any of the above-named colors mixed with mastic varnish;—this varnish also is used when it is desired that the fruit should be very shining, as cherries are; if rough-coated fruit be wanted, as, for example, the peach, it must be cast as usual, then colored on one side by dry lake, varnishing, and immediately after varnishing be sifted over with paper powder. *(See page 62.)* The bloom of red plums, and dark grapes, is made by dusting over them powder-blue from a muslin bag. Strawberries, cherries, and other small fruit, are always cast solid; that is, after the mould is made, instead of pouring in the wax to the one half and putting the other on it, a hole is made at the crack between the two halves, and the mould being held upright, wax is poured in until the mould is full.

Grapes are formed of glass globes made on purpose; these are of varied size, and have each a small nozzle or mouth like that of a phial. To fit them up in bunches, take some pieces of iron wire, twist a piece of sewing cotton near one end of each wire, so as to fit the mouth of a certain grape; dip it into melted wax, and insert it into the mouth, when it will become fixed there; then dip the grape thus formed into melted wax, colored of a very light green; taking it out instantly it will dry, having a coat of the wax upon it, which gives it much the appearance of a real grape. Several being thus made, they may be tied together in bunches according to fancy—about thirty in a bunch. Currants are made with similar but smaller glass globes, and in a similar manner; but to give them the peculiar appearance of the opaque lines seen upon them, a piece of sewing cotton is to be wound in sections around the fruit previous to dipping. The remains of the flower at the end of an apple, pear, &c., is imitated by a clove being thrust into the waxen image.

Anatomical preparations, of which many are so complex, and so beautifully illustrative of morbid anatomy, cutaneous disorders, &c., are all made in exactly the same manner as the directions given for waxen fruit, and colored after casting with common oil colors by precisely similar methods. Thus, although the above may, from the name given to the article, appear trivial, yet, as the same principles are acted upon in working with wax generally, and it may be added casting and moulding also, the art becomes important from its varied objects and useful applications.

ORIGIN OF BITUMINOUS SUBSTANCES.

Nature of Coal.—Coal is a mass of vegetable matter, transmuted by chemical changes into carbon, and still exhibiting the structure of the plants from which it was derived. When sections of coal are seen through the microscope, the fine, reticulated structure of the original is distinctly visible, the cells of which are filled with a light, amber-colored matter, apparently of a bituminous nature, and so volatile as to be readily expelled by heat, before the texture of the coal is destroyed.

Mr. Parkinson, whose work abounds in most interesting observations and experiments on the fossilization of vegetable substances, has shown that the production of coal has depended upon a change which all vegetable matter undergoes when exposed to heat and moisture, under circumstances that exclude the air, and prevent the escape of the more volatile principles. In this condition, a fermentation, which he terms the bituminous, takes place, of which the phenomenon, exhibited by *mow-burnt hay*, is a familiar example. Were vegetable matter under the circumstances here described, placed beneath great pressure, so as to confine the gaseous principles, bitumen, lignite, or coal, might be produced, according to the various modifications of the process.

Mineral Oil, Naphtha, and Petroleum.—Springs or wells of the inflammable substance called *Mineral Oil*, occur in many countries, as Persia, Calabria, Sicily, America, &c.; generally in rocks associated with coal. *Naphtha* is nearly colorless, and transparent, burns with a blue flame, emits a powerful color, and leaves no residuum. Genoa is lighted with naphtha from a neighbouring spring. *Petroleum* is of a dark color, and thicker than common tar; in some parts of Asia, this substance rises from coal-beds in immense quantities. From a careful analysis of petroleum, and certain turpentine oils, it is clear that their principal component parts are identical: and it appears, therefore, evident that the petroleum has originated from the coniferous trees, whose remains have contributed so largely to the formation of coal; and that the *mineral oil is nothing more than the turpentine oil of former ages*—not only the wood, but also large accumulations of the needle-like leaves of the pines may also have contributed to the process. We thus have the satisfaction of obtaining, after the lapse of thousands of years, information as to the more intimate composition of those ancient destroyed forests of the period of the great coal formation, whose comparision with the present vegetation of our globe is the subject of much interest and investigation. The mineral oil may be ranked with amber, succinite, and other similar bodies which occur in the strata of the earth. The occurrence of petroleum in springs does not seem to depend on combustion, as has been supposed, but is simply the result of subterranean heat. According to the information we now possess, it is not necessary that strata should be at a very great depth beneath the surface to acquire a heat equal to the boiling point of water, or mineral oil. In such a position the oil must have suffered a slow distillation, and have found its way to the surface; or have so impregnated a portion of the earth, as to enable us to collect it from wells, as in various parts of Persia and India. The author of an interesting paper in the "American Journal of Science," remarks that petroleum is now daily discharging into the soft mud and gravel in the beds of the Muskingum and Hew's rivers. At Chilley, in Sussex, beds of shanklin sand are permeated throughout with bituminous oil, originating either from neighbouring peat-bogs, or from lignite beds of the Wealden.

(Continued on page 87.)

PAPIER MACHEE, &c.

Papier Machèe consists of cuttings of white or brown paper, boiled in water, and beaten in a mortar till they become a kind of paste, and mixed with a solution of gum arabic in size, to give tenacity to them. The pulpy mass thus formed is made into tea-boards, toys, &c., by pressing it into oiled moulds. When dried it is covered with a mixture of size and lamp black, and afterwards varnished.

It is from this material that the scrolls, wreaths, and rosette ornaments for theatres, decorative cornices, &c., are frequently made, being gilt afterwards. Also, the French, who excel in papier machèe work, are accustomed to make numerous models, painting them with fresco colors—that is with various pigments mixed with whiting, or some opaque color. Of this description have been formed models of the chief routes through Switzerland, in which the foundation, or general surface, is of paper, formed irregularly, and colored to resemble mountains, &c. The glaciers are of coarsely pounded glass—the roads painted brown—the rivers blue—the woods made of the pile of velvet cut off, and the villages of cork.

Paper Paste is very similar to the last, but made of white paper, boiled in water for five hours. Then the water being poured off, the pulp is pounded in a Wedgewood mortar, passed through a sieve, end mixed with a little gum water, or else isinglass-glue. Some years since there was at Bath, an exhibition, called the *Papyrusium*, consisting of some hundreds of beautiful groups of figures and landscapes, made wholly of fine paper paste, by Mrs. Aberdeen, in which the delicate color and plastic character of the material were finely exemplified. It is at present used as a modelling material, chiefly to make the finer mouldings and statues in paper architectural models, and for which M. Deighton is so celebrated.

Pollen Powder, or *Paper Powder*, is the above pulp dried, pounded fine, and passed through a sieve, the size or gum water being omitted. It is employed by the bird stuffers to dust over the legs of some birds, and the bills of others, to give them a powdery appearance; also to communicate the downy bloom to rough-coated artificial fruit, and other purposes of a similar nature: it makes excellent *pounce*.

METHOD OF TRAINING VINES IN POTS FOR FORCING.

A VINE sufficiently strong for the purpose of forcing (previously grown in a pot, and at the age of two years from the layer) should be shifted into a pot of suitable size and compost, and cut down any time in the autumn or winter months. In the spring it should be placed close to a south wall. Allow one or two shoots only to be produced; these should be constantly kept nailed close and divested of side shoots, and the surface of the pot mulched, and watered occasionally, if necessary. In the autumn, when the summer growth is over, prune down by cutting off the imperfectly ripened wood, and remove the plant to a north aspect, where it may receive a sufficient hybernation or winter check from the first frosts, securing the shoot or shoots from the wind. When the time arrives for the plant to be taken into the forcing-houses, provide six or eight straight, well painted, taper sticks, about 3½ feet long. Pplace them at equal distances round the stem all leaning outwards, and fixed to a hoop at top, forming a trellis, like an inverted cone. On this, train the shoot or shoots; ascending spirally at the distance of eight or ten inches from each other; continuing the volutions as far as the shoots will extend. When the vine is thus trained, examine the position of the buds, and cut off all those which would shoot inwards: this will prevent the tree from becoming crowded; and those only on the outside being suffered to shoot, and stopped immediately beyond the fruit, will have freedom for their leaves and bunches, without resting on the frame or on each other. This is the most convenient form for training vines in pots: it allows the natural, and therefore the necessary, length of shoot, and is the position of all others the most conducive to fruitfulness.—*Gard. Mag.*

POWER OF CARBONIC ACID ON THE LUNGS.

WHEN M. D'Arcet went to visit the very abundant and curious source of carbonic acid, existing at Montpensier, in the department of Puy de Dome, he endeavoured to ascertain personally the effect of the gas when respired. He kneeled down, therefore, near the larger source, supporting himself on his hands, and advanced his head slowly downward, intending to raise himself the moment he felt any indication of risk; but on commencing the respiration of the gas, the effect of feebleness and extinction of power was so sudden, that he fell down flat, with the face entirely immersed in the current of carbonic acid, and would have lost his life, but that the guide whom he had forewarned, raised and carried him away to the fresh air.

M. D'Arcet proposes two curious uses of the place. The nature of the ground, assisted by certain protecting hedges, will enable the carbonic acid to collect in great quantities. A cistern is to be formed at the lowest level, and then when animals come to drink the water, or are tempted by the green shade, they will be killed, and thus much game is calculated upon for the advantage of the village. Then a house is to be built with an inclined floor, a pully, a double rope, &c., so that a dog may be tied to the rope, led into the carbonic acid atmosphere in the house, rendered insensible, hauled up again, and revived by the fresh air: and thus by making the celebrated experiment of the Grotto del Cane in a scientific way, much company, it is expected, will be drawn to the place.

REVIEW.

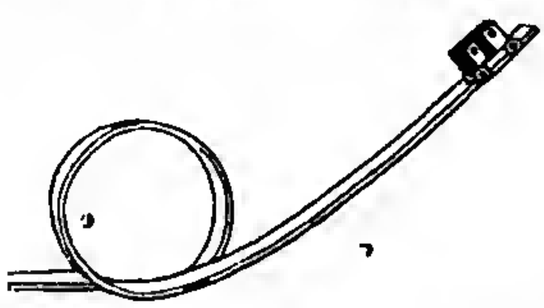
Illustrations of Mechanics.—By Professor Mosely, King's College.—Price 5s.

THE public were long ago informed that the Professors of King's College had it in contemplation to publish a series of books for the use of their pupils, upon the subjects of their respective appointments, as teachers. This is the first of that series, and is well adapted to the purpose for which it was written—the instruction of youth; it, however, goes no farther than this, being written in a popular, rather than in a scientific and learned style. It reminds us very much, both in style and arrangement, of "Dr. Arnott's Elements of Physics." It is divided into numerous chapters, divisions, and sections, containing the old routine of the mechanical powers, forces, properties of matter, &c., with very little that is new by way of illustration, and not a word, except incidentally, as to the application of mechanical principles to the purposes of manufactures or locomotion—scarcely anything upon those all-important subjects of friction and wheel-work—and nothing whatever upon the many contrivances relative to alteration of motion. Notwithstanding this it is a useful synopsis, as we said before, for youth, though we cannot think that it is to be compared with the "Elementary Works" of Messrs. Chambers, one of which we have before noticed. The

following extracts will show better the style and manner than anything we can aver:—

"*The dimensions of the earth have not diminished for the last* 2,500 *years.*—No obstacle being opposed to the force of motion with which the earth rotates, that force must be the same now that it always was. But if, by the contraction of the earth's mass, its parts are brought now nearer to the axis about which it rotates, than they were formerly, it is clear that these, revolving at a less distance, must, to have the same force of motion, revolve *faster*—so that if the earth's diameter had contracted, the *day* would now be shorter than it was. Now we have observations which show, that the day is now precisely of the same length that it was 2,500 years ago. None of that diminunition of bulk from the cooling of its mass, of which geologists speak, can, therefore, have taken place, with any perceptible influence, within that period.

"*To make a carriage run in an inverted position without falling.*—Let a bar of iron be turned round, so as to form a circle, the two ends being brought out into two inclined planes, and the two curved portions of the bar being made to lie a small distance apart at the point where they pass each other. This bar being now placed with the curved portion of it in a vertical position, let a small heavy carriage be placed at one of its extremities with wheels, on the outside of which are flanches, to keep it as it rolls upon the bar. Descending the inclined plane, this carriage will ascend the curve, and if the point from which it has descended be high enough, the velocity it will have acquired will cause it to ascend, to the *top* of the curve, and give to it a sufficient centrifugal force at that point to overcome its gravity, and cause it to run on in that inverted position without falling. It will thus descend in safety on the opposite branch of the curve, and will again be brought to rest as it ascends the opposite inclined plane towards the other extremity of the bar. This ingenious illustration of the effect of centrifugal force was devised by Mr. Roberts, of Manchester.



"*The dynamical effect of a human agent.*—The muscular power of a man is usually made to operate either by his legs or his arms, rarely by both together. It has been estimated that by the action of his legs upon a tread-wheel, he can raise his own weight, about 150 lbs., 10,000 feet per day, which gives a dynamical effect of 1,500,000 feet per day, or 3,125 per minute, supposing the work to be continued eight hours a day. A man who ascended a hill 10,000 feet high, would do a good day's work, a result which corroborates the preceding. In respect to the dynamical effect of a man working with his arms, we have the authority of Smeaton, that a good laborer can thus raise 370 lbs. 10 feet high per minute, being somewhat greater with his arms than his legs. Desaguiliers makes the dynamical effect of a man working with his arms 5,500 per minute, this is, however, considered too high an estimate.

"*The dynamical effect of a horse.*—A horse drawing a weight out of a well over a pulley can raise 200 lbs. for eight hours together, at the rate of two miles and a half, or 13,000 feet per hour. This gives for the dynamical effect of a horse per minute 29,333. The usual estimate of the dynamical effect per minute of a horse, called by engineers a horse's power, is 33,000. Mr. Smeaton states it to be 22,000.

"*The dynamical effect of* 1 *lb. of coals.*—The power of heat which slumbers among the particles of a mass of coal, is best called into operation as a dynamical agent, by combining it with *water* under the force of steam. According to Mr. Watt a bushel of coals (84 lbs.) will convert into steam ten cubic feet of water; so that 8 lbs. is sufficient to evaporize one cubic foot. Now one cubic foot of water, according to Tredgold, will expand itself into 1,711 cubic feet of steam, at a temperature of 212, and retaining an elasticity equal to the pressure of one atmosphere. These 1,711 cubic feet of steam are, therefore, capable of propelling a piston of one foot square, under the pressure of one atmosphere, through a distance of 1,711 feet. Now the pressure of the atmosphere on a surface of a foot square is 2,120 lbs. These 8 lbs. of coals, thus converting into steam a cubic foot of water, are capable, therefore, through this intervention of the steam, of producing a dynamical effect represented by the product of 1,711, multiplied by 2,120, or by 3,627,320. This effect being produced by 84 lbs., the effect of one pound is obtained by dividing it by 84, by which division we find 431,824 for the dynamical effect which 1 lb. of coals is capable of producing."

MISCELLANIES.

Caoutchouc Balloons.—Put a little ether into a bottle of caoutchouc, close it tightly, soak it in hot water, and it will become inflated to a considerable size. These globes may be made so thin as to be transparent. A piece of caoutchouc, the size of a walnut, has thus been extended to a ball 15 inches in diameter; and a few years since, a caoutchouc balloon, thus made, escaped from Philadelphia, and was found 130 miles from that city.

To Color Unsized Prints.—Those who color engravings, which have been printed on unsized or bibulous paper, make use of the following composition, which is very similar to that employed in the paper manufactories. Four ounces of Flanders glue and four ounces of white soap are to be dissolved in three pints of hot water. When the solution is complete, two ounces of pounded alum must be added, and as soon as these ingredients are well mixed, the composition is fit for use. It is applied cold with a sponge, or rather with a flat camel-hair brush.

Resin Bubbles.—Dip the bowl of a tobacco-pipe into melted resin, hold the pipe in a vertical position, and blow through it, when bubbles of various sizes will be formed, of a brilliant silvery hue, and in a variety of colors. This is the method pursued by the Italians to make the imitation bunches of grapes, which are sold by them at a few pence. These grapes are fastened together, and then dusted with powder-blue.

Patent Atmospheric Railroad.—A series of experiments have been lately made with Mr. Clegg's atmospheric railway. The principle of which is exhausting a tube of its atmospheric air, and thereby drawing along a piston, which has a rope and carriages attached to it. But perhaps it will be

better understood in the patentee's own words, especially as we have not ourselves seen it. "Clegg's atmospheric railroad is worked by stationary steam engines, apart from each other two to five miles, according to the nature of the country. Two engines are fixed at each station, one for the up, the other for the down train, excepting on long inclined planes, where one engine only is requisite. The power is communicated to the trains by means of a pipe laid between the rails, which is exhausted by air pumps, worked by the engines. A piston is fitted to the pipe in such a manner that it will slide air-tightly therein. The pressure on the back of this piston, when the pipe is exhausted, is equal to a column of mercury, twenty inches high. An available tractive force is thus obtained of 714 lbs., which will draw a train weighing thirteen tons up an ascent of one in fifty. With engines of the above-named power, the train can be impelled at the rate of thirty-five miles per hour, and the sections of the pipe exhausted with sufficient rapidity to admit of a train being dispatched each way every ten minutes, or if we make allowance for all possible delay, four trains each way may be transmitted per hour, making a total of 2,496 tons per day."

New Light for Light-houses.—A letter of the 10th March, from Trieste, states that a new system of producing light for light-houses has been invented by a serjeant-major in the Austrian artillery, named Selekonsky. The apparatus consists of a parabolic mirror, 62 inches by 30, with a 12-inch focus, and the new light is produced by a new kind of wax candle, invented by M. Selekonsky. It has been tried under the inspection of the Austrian Lloyd's Company, in the port of Trieste, by being erected on the mast of a vessel. The light is said to have illuminated the whole of the port and the surrounding parts of the town equal to the moon at full, and at the distance of 600 yards the finest writing could be read. A second trial has been made in bad weather, and the result was proportionably favorable.

To Inlay Mother-of-Pearl Work.—In Birmingham, (to save time,) the fragments of pearl are cut into shapes with press-tools. Tortoiseshell is softened by soaking it in hot water—the design is arranged, and placed between flat dies, under a heavy press, to remain till the shell is cold and dry. It is thus embedded in the shell. Those vivid colored particles seen on paper trays, &c., are fragments of the Aurora shell, pressed in the same way, while the paper is damp; when dry, the design is painted, varnished, baked, and polished.

Heat passing through Glass.—The following experiment is by Mr. F. Talbot, F.R.S. Heat a poker bright red hot, and, having opened a window, apply the poker quickly very near to the outside of a pane, and the hand to the inside; a strong heat will be felt at the instant, which will cease as soon as the poker is withdrawn, and may be again renewed, and made to cease, as quickly as before. Now, it is well known, that if a piece of glass is so much warmed as to convey the impression of heat to the hand, it will retain some part of that heat for a minute or more; but in this experiment, the heat will vanish in a moment. It will not, therefore, be the heated pane of glass that we shall feel, but heat which has come through the glass, in a free or radiant state.

Rice Glue.—Mix rice flour intimately with cold water, and gently simmer it over the fire, when it readily forms a delicate and durable cement, not only answering the purposes of common paste, but admirably adapted to join together paper, card, &c. When made of the consistence of plastic clay, models busts, basso relievos, &c., may be formed; and the articles, when dry, are very like white marble, and will take a high polish, being very durable. In this manner the Chinese and Japanese make many of their domestic idols.

Conducting Powers of Metals to Heat.—Hold in the flame of a candle, at the same time, a piece of silver wire and a piece of platinum wire, when the silver wire will become too hot to hold much sooner than the platina. Or cut equal pieces of each wire, tip them with wax, and place them upright upon a heated plate (as a fire-shovel), when the wax will be seen to melt at different periods.

Indian Rubber Carpets.—Having some Indian rubber varnish left, which was prepared for another purpose, the thought occurred to the writer, of trying it as a covering to a carpet, after the following manner:—A piece of canvass was stretched and covered with a thin coat of glue, (corn meal size will probably answer best,) over this was laid a sheet or two of common brown paper, or newspaper, and another coat of glue added, over which was laid a pattern of house papering, with rich figures.—After the body of the carpet was thus prepared, a very thin touch of glue was carried over the face of the paper to prevent the Indian rubber varnish from tarnishing the beautiful colors of the paper. After this was dried, one or two coats (as may be desired) of Indian rubber varnish were applied, which, when dried, formed a surface as smooth as polished glass, through which the variegated colors of the paper appeared with undiminished, if not with increased, lustre. This carpet is quite durable, and is impenetrable to water, or grease of any description. When soiled, it may be washed, like a smooth piece of marble or wood. If gold or silver leaf forms the last coat, instead of papering, and the varnish is then applied, nothing can exceed the splendid richness of the carpet, which gives the floor the appearance of being burnished with gold or silver.

QUERIES.

56—How is glass stained? *Answered on page* 251.

57—When a shred of camphor is placed on water it swims round in circles, but if a little grease be dropped in it stops, and seeks the side of the vessel. What is the reason of this? *Answered on page* 104.

58—How can a precipitate be formed from a decoction of cochineal? *Answered on page* 104.

59—How are quills clarified? *Answered on page* 88.

60—Why do lobsters become red in boiling? *Answered on page* 160.

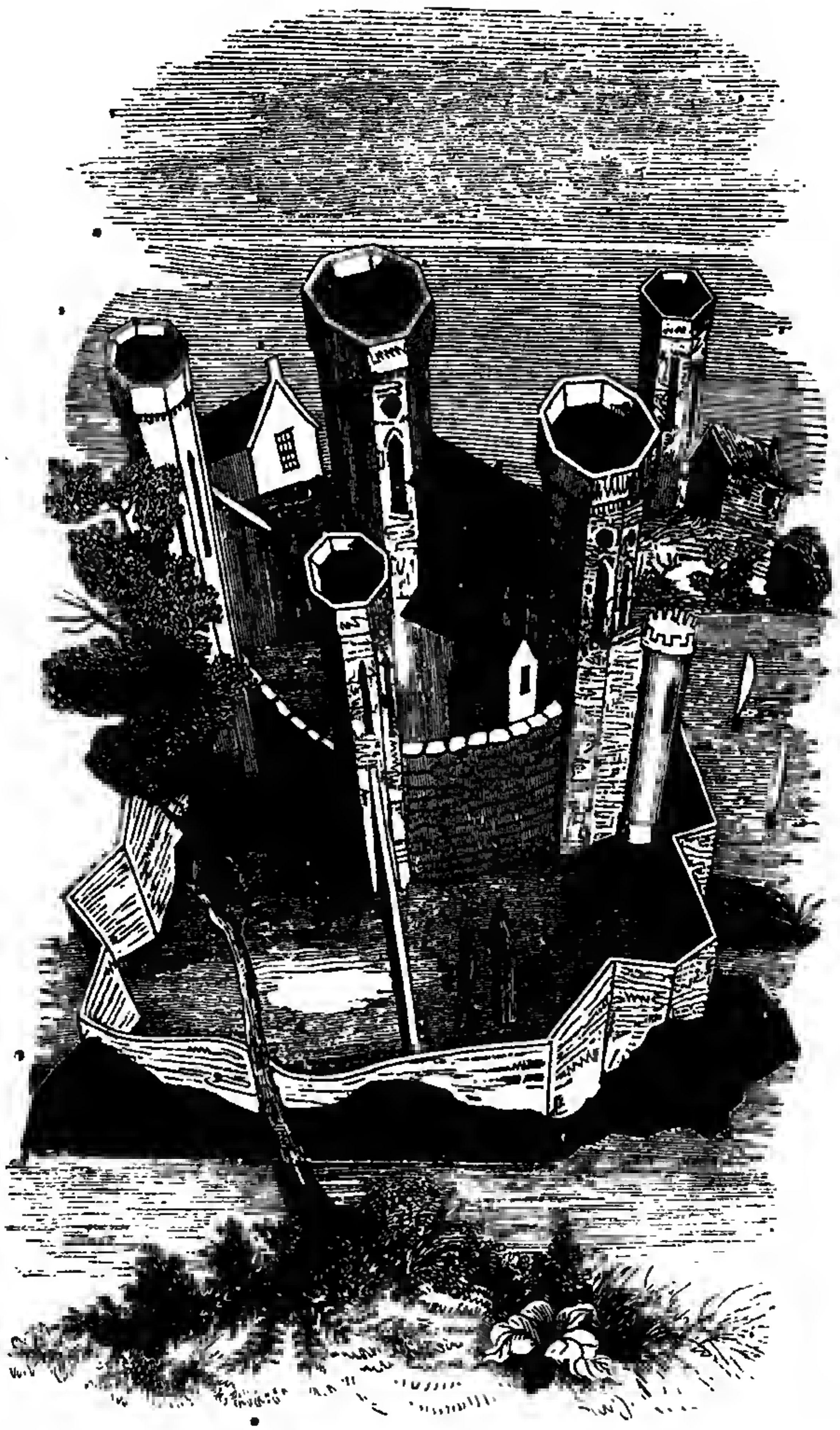
61—How can silver be gilt without the use of mercury? and is it practicable to gild silver previous to its being burnished? *Answered on page* 104.

62—How is Indian rubber to be artificially moulded into shoes, &c.? *Answered on page* 413.

63—Can gluten be, by any process, made to answer the same purpose as Indian rubber? *Answered on page* 104.

64—What is the mode of preparing the Fecule, advertised as Tous les mois, or Canna Root? Chemical analysis can scarcely prove the plant from which any kind of fecule is derived. The grains of the fecula of the potatoe, and also those of the Canna plant are comparatively large, and various in shape. If, therefore, Tous les mois be not in reality potatoe starch, as the querist supposes, this latter may certainly be substituted for it without detriment.—Ed.

65—How are medallion wafers to be made? *Answered on page* 413.



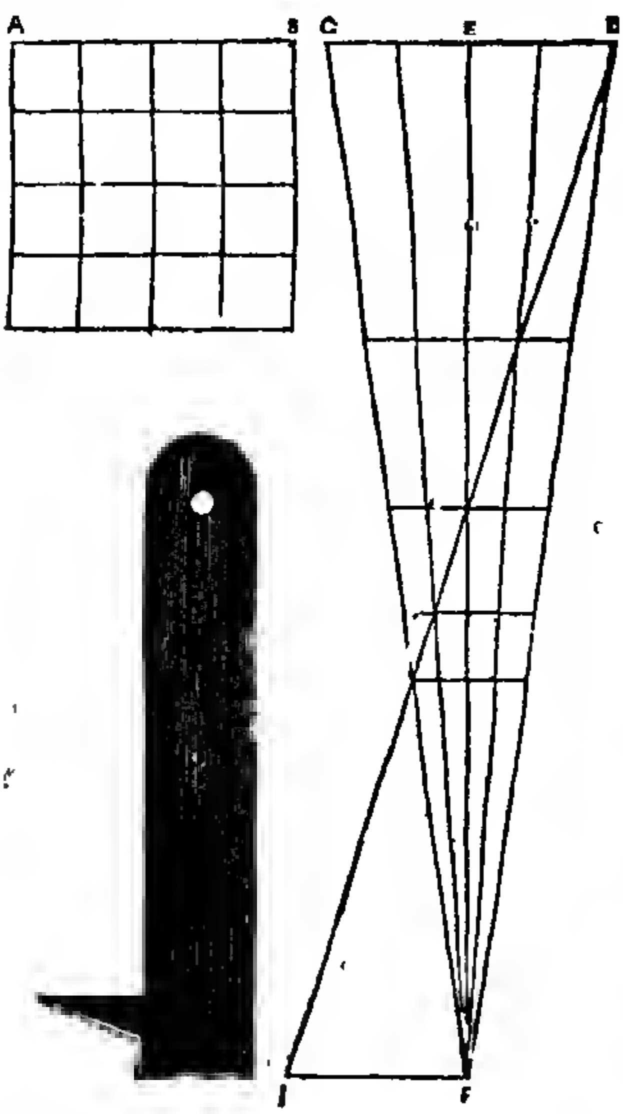
ANAMORPHOSIS, OR HORIZONTORIUM.

ANAMORPHOSIS, OR HORIZONTORIUM.

The Horizontorium is one of those monstrous projections, which, under ordinary points of view, appears extravagantly distorted and ridiculous, yet seen from a particular situation, the picture strikes the eye as one of complete symmetry. This optical illusion is considered as of comparatively modern invention, but this is by no means the case, as a description of it, under the name of Anamorphosis, appears in the very oldest books on mathematical amusements; the correct delineation of the picture depending upon the simplest rules of mathematics and perspective. The Horizontorium is but a revival therefore of the more ancient Anamorphosis, and lately the same recreation has appeared under various new names, though precisely the same view being given as the illustration.

Fig. 1.—Shows a castellated building surrounded by its wall, the turrets appear ready to fall, leaning in different directions, away from the centre; not a line is upright. The turrets too are larger at the upper part than below, are much too tall for their width, and the whole view appears distorted. If however a piece of card be cut of the size and shape of the darker object in Fig. 2, a hole about as large as a pea be made in the upper part, and the lower end of the card bent to form a foot, as represented, and this piece of card be placed at that point where all the lines that bound the various turrets would converge (which will be found seven inches and a half below the top of the highest turret), the whole view will appear in its just proportions, representing a castle at a considerable distance, the loftiest part of which appearing scarcely an inch high.

Fig. 2.



The preceding is the mathematical construction of the distorted view.

Suppose A B, Fig. 2, to be a common square picture, which it is desired to distort; divide the square into a number of smaller squares at pleasure; then draw the line C D equal to the breadth of the view required. Bisect C D in E, and draw E F equal to the distance at which the view is to be seen. From F draw F I perpendicular to E F, and make F I equal to the height of the eye-hole in the card, or the exact point of sight. Join I D; divide C D into the same number of equal parts as you had first divided the line A B. Draw lines from each of these points of division to the point F; and cross lines at the various points of their intersection with the line D I, a parallelogram will thus be formed, divided into the same number of smaller parts as the square A B. It is now only requisite to draw upon each of these that part of the original picture corresponding to it, and the whole will appear in just proportion at the distance F, and the height I above the plane.

ON FERMENTATION.

Vegetable substances are composed almost wholly of oxygen, hydrogen, and carbon; and owing to the numerous and energetic affinities with which these, their elements, are endowed, vegetables are very prone to spontaneous decomposition.

To the changes which take place, the term *Fermentation* is applied; a mysterious process, which, notwithstanding the deep researches of Lavoisier, Sausseur, and more modern chemists, is not even now susceptible of a satisfactory explanation. There are five distinct kinds of fermentation: the saccharine—vinous—panary—acetous—and putrefactive; each of which offers phenomena and results peculiarly its own. To offer a few remarks upon each of these is the object of the present essay.

The Saccharine.—Whether the deposition of gum, oil, wax, resin, &c. arises from any species of fermentation, is among chemists a matter of some dispute; it appears most probable, however, that these bodies, the whole of which are compounded of oxygen, hydrogen, and carbon, are the result of some peculiar circumstances of vegetable life, and not formed by any action which can bear the character of a general decomposition; sugar, however, from its capability of being produced by artificial means, and from the ready conversion of gluten and woody fibre into this substance, gives rise to a belief that although, occasionally, it may be a vegetable deposit, yet that in many cases it is the result of fermentation. Thus in the germination of seeds, part of the gluten is converted into sugar. In the malting of barley, which is but germination artificially produced, this is seen in a very conspicuous manner. The ripening of fruit is attributed also to the saccharine fermentation, especially as many fruits, if gathered before their maturity, ripen by keeping.

The Vinous.—This is the most useful and important of all the kinds of fermentation. It is that produced in the making of all wines, beer, cidar, mead, spirits, &c. If the juice of any ripe fruit, or a decoction of seeds, as of malt, or sugar and water in proper proportions, be mixed with a small quantity of yeast, and heated to a temperature of 70°, the vinous or spirituous fermentation commences, the various ingredients act upon each other, a decomposition of some of them takes place; the

liquor becomes thick and turbid; the temperature increases, and carbonic acid gas is evolved. In a short time, the brisk fermentation ceases; the liquor becomes clear, and it has lost its sweet flavor; its sugar has become converted into alcohol, or spirit, and carbonic acid; nearly equal in weight to the sugar decomposed.

Although most vegetable substances will ferment if kept warm and moist, yet to produce this kind, five things appear to be necessary;—warmth, water, sugar, a vegetable acid, and gluten. Thus in the making of wine, the juice of the fruit, or as it is called *must*, contains the acid, gluten, sugar, and water, and therefore it follows that if it be kept warm, it would pass on to the vinous fermentation, but as in many cases it would not ferment quick enough to make wine, it is customary to dilute the must with water, and to put into it some sugar, with a small quantity of yeast, to hasten the process. The juice of unripe fruits will scarcely ferment at all, because of the excess of acid they contain; thus the juice of unripe grapes is a rough, acid liquor called *verjuice*, and will for many years remain in the same inactive state; but grapes come to maturity can no sooner be pressed into a vessel, than they become a fermentable liquor, and in moderately warm countries so rapid does the vinous fermentation proceed, that in a very few hours, the liquor is of intoxicating properties.

The Panary.—Is that which is produced in the manufacture of bread. The yeast which is used causes a quantity of carbonic acid gas to be evolved, which being prevented from escaping, by the stiff nature of the dough, occasions throughout the whole mass a number of vesicles, or air bladders, which render the bread light and porous. Some philosophers have been of opinion that this fermentation is distinct from every other, starch being the material decomposed; others, among whom is Dr. Colquhon, affirm that it is identical with the vinous, and the circumstance of the steam arising from an oven of bread, yielding alcohol, goes very far to prove the correctness of his views. A manufactory has been erected in London for the purpose of collecting the spirit emitted by dough in the process of baking. It may not be deemed irrevelant to mention here a method of making bread on a new principle, introduced by Dr. Whiting. It consists in the decomposition of carbonate of soda dissolved in water, and mixed with flour so as to form the consistence of dough, then muriatic acid is added in the exact proportion for saturating the carbonate of soda, it is then ready for baking. It will be understood that the acid combines with the soda, and forms chloride of sodium, or common salt; tha carbonic acid gas is set free, by which means the bread is rendered *light*, as in the common process, and of a more uniform quality.

The Acetous.—It is so called because after bodies have passed through it they become sour; if liquid the result is called vinegar, or acetous acid. Although the vinous fermentation is most useful, yet this is the most common. Bread, or rather dough, becomes sour, if exposed to the air and sun; sugar and water is affected in the same way, and also most liquids which have passed the vinous fermentation will turn to vinegar. However such as are very strong, or which contain a large portion of spirit, resist tha action of the air and sun until the spirit is evaporated; oxygen gas is then absorbed from the atmosphere, and acetic acid is formed; should tha liquid be confined in close vessels, it would be far less liable to run into acidity. It is not to be inferred from the above that the acetous fermentation must be preceded by the vinous action; on the contrary, acidity is often produced in substances where no trace of any previous decomposition is apparent; many substances ferment in the stomach, and occasion acidity, without the smallest reason to suppose that alcohol has previously been formed there; and sour pastes, sour jellies, meats and milk are but instances of the acetous fermentation, not preceded by the vinous.

The Putrefactive.—Is too common not to have been repeatedly observed in its effects. The conditions which are required for enabling the putrefactive process to take place are moisture, air, and a temperature above the freezing point. The nature of the chemical action in putrefaction are exceedingly obscure—it takes place in vegetable and in animal bodies. Those which have passed through the other states of fermentation are equally liable to this process as those bodies which are not susceptible of either of them; sometimes it proceeds rapidly, as in warmer climates; sometimes so rapidly indeed that in a few minutes, sweet and wholesome meat becomes nauseous and putrid, putting on various colors, and exhaling ammonia, nitrogen, and sulphuretted hydrogen. Vegetables decay more slowly, but the process of putrefaction sooner or later attacks and destroys them; we see the decay of the hard trunk takes place as surely, though not so quickly, as that of the perishable grass; and the fœtid smell, mouldy appearance, or earthy residuum of the fallen leaf; the stagnant solution, or the putrifying insect, is but a type and an example of that putrefactive fermentation which awaits all animated nature.

W. B.

[Another kind of fermentation our correspondent has omitted to notice; it is called the *Bituminous*, and is alluded to in the paper in the last number, on the formation of coal. Some have supposed that the luminosity seen in some decaying trees, in tha phosphorescence of the ocean, and in various shell-fish when becoming putrid, is properly a distinct kind of fermentation, called the *Electrical.*—Ed.]

ORIGIN OF BITUMINOUS SUBSTANCES.

(Resumed from page 62, and concluded.)

Bitumen, Amber, and Mellite.—Bitumen may be described as an inspissated mineral oil; it is generally of a dark-brown color, with a strong odour of tar. In the Odin mine of Derbyshire, a species occurs which is elastic, being of the consistence of thick jelly, and bearing some resemblance to soft India-rubber; as it will remove the traces of a pencil, it has been named mineral caoutchouc. Some specimens possess the color and transparency of amber; the soft bitumens may be rendered solid by heat.

From this bituminous substance to *Amber* we pass by an easy transition; for black amber bears, both in its appearance and composition, a close resemblance to the solid bitumens. The nature of common amber is too well known to need remark; its electrical properties, odour, combustion, and the fact of its inclosing insects, leaves, and other foreign bodies, indicate its origin and former condition. This substance is found in nodular masses, which are sometimes eighteen inches in circumference; it occurs in beds of lignite, and on the coast of Prussia in a subterranean forest, probably of the newer tertiary epoch. Mr. G. B. Sowerby

mentions having seen, at Baden, the branch of a tree converted into jet, and having the centre filled with amber. In the brown coal of Mukaw, amber occurs in the fossil coniferous wood, partly in disseminated portions, and *partly in the resin-vessels themselves;* and fir-cones are frequently discovered which contain this substance on and between the scales. Amber has also been found in coniferous plants associated with ferns, in coal that is referred to the upper secondary formations. In fine, there can be no doubt that amber is an indurated resin, derived from various coniferous trees, and which occurs in a like condition in all zones, because its usual original depositories, the beds of brown coal, have been formed almost everywhere under similar circumstances.

A mineral substance, called *Mellite*, or honey-comb, from its color, is found among the bituminous wood of Thuringia. In its chemical composition, and electric properties, it bears a great analogy to amber; it is usually crystallized in small octahedrons. In the tertiary beds of Highgate a fossil resin, resembling copal, has been discovered.

The Diamond.—The chemical constituents of this substance are chiefly carbon or charcoal, and hydrogen, with a small proportion of oxygen—the essential characters of vegetable matter. In the diamond we have the elements of pure carbon; at a heat less than the melting point of silver, it burns, and is volatilized, yielding the same elementary products as charcoal. Sir Isaac Newton long since remarked, that the refractive power, that is, the property of bending the rays of light, was three times greater in respect of these densities, in amber and in the diamond, than in other bodies; and he therefore concluded that the diamond was some unctuous substance that had crystallized. Sir D. Brewster has observed, that the globules of air (or some fluid of low refractive power) occasionally seen in diamonds, have communicated, by expansion, a polarizing structure to the parts in immediate contact with the air-bubble, a phenomenon which also occurs in amber. This is displayed in four sectors of polarized light encircling the globule of air; a similar structure can be produced artificially, either in glass or gelatinous masses, by a compressing force propagated circularly from a point. This cannot have been the result of crystallization, but must have arisen from the expansion exerted by the included air on the amber and the diamond when they were in so soft a state as to be susceptible of compression from a very small force; hence Sir D. Brewster concludes that, like amber, the diamond has originated from the consolidation of vegetable matter, which has gradually acquired a crystalline form by the slow action of corpuscular forces. The matrix of the diamonds of Southern India is the sandstone brecia of the clay-slate formation. Capt. Franklin observes that in Bundel Kund, diamonds are imbedded in sandstone, which he supposes to be the same as the new red sandstone, for there are at least 400 feet of that rock below the lowest diamond beds, and strong indications of coal underlying the whole mass.

Anthracite, Cannel Coal, Plumbago.—The coal commonly used for domestic purposes in this country is bituminous coal; containing, as before stated, a volatile, inflammable fluid, in a cellular structure. The stone-coal, or anthracite, as it is termed, appears to be coal deprived of its bitumen; for it is well known that when basalt is in contact with coal, the latter is in the state of anthracite; and in some instances is even converted into plumbago, the substance of which black-lead pencils are constructed. Anthracite generally occurs in rocks of an earlier date than those which are strictly comprised in the carboniferous group; but it is convenient to notice the nature of the rock in this place, in connexion with the substance of whose vegetable nature no doubt can exist. By a series of interesting experiments, Dr. MacCulloch has shown that there is a natural transition from the bitumen to plumbago. Hydrogen predominates in the fluid bitumen; bitumen and carbon in coal; in anthracite bitumen is altogether wanting; and in plumbago the hydrogen also has disappeared, and carbon only, or chiefly, remains.

BIRD STUFFING.

(*Resumed from page 30, and concluded.*)

Whatever care may have been bestowed upon the skinning and stuffing of the skin will be but thrown away, unless it be afterwards well mounted, that is, placed in an easy and natural position, its feathers smoothed, its legs and wings properly bent, its eyes well set, and its beak corresponding to the attitude of its body.

To attain perfection in mounting birds, considerable skill, taste, and knowledge of natural history is requisite. These qualifications cannot be communicated, but the following hints may lead attention to the more difficult points, and direct the thoughts into the requisite direction. After the bird skin is stuffed as before directed, the first thing to be done is to place within their orbits the artificial eyes. These it need not be said must correspond with their natural colors: thus the eyes of the canary bird, and, indeed, most small birds, are black; those of the pheasant red and black, and so on. The orbit of the eye will hold a much larger globe than is to be seen outwardly; when, therefore, the eye is properly placed, draw over the front part of it the eye-lid, with a wire or needle, or the eyes will appear staring and prominent; and put under and around the lids a little strong gum-water, which will prevent them afterwards shrinking.

The next thing is to affix the specimen upon the sprig or branch which is to support it. This is done by boring two holes through the proper part of the sprig, for the wires connected with the feet to pass through. The toes are to be drawn down close, and properly placed—the wires twisted tightly around the sprig to hold it firmly, and the superfluous ends of the wires cut off close. The intended position that the bird is to be placed in is next to be considered: suppose a common sitting, or standing posture, with close wings be required, it is necessary to bend the legs according to the natural habit of the birds. The water-fowl have them usually but little bent—the running birds, such as the partridge, quail, &c., more so, but still less bent than those of rapid flight, and which roost at night. The attitude, however, of the specimen will make a great difference in this respect. The head, neck, tail, and wings, are then bent, and fixed according to the expression intended to be conveyed. The wires, (which have already been placed up the legs, along the body, and through the skull,) are sufficient to poise the head, and bend the legs properly. If the wings are not required to be extended, it will only be necessary to put them into their proper position, and tie them round with a little fillet of paper until the bird is

dry. If to be extended, you must pass a wire from the elbow joint, beneath the skin of each wing into the body of the bird—these will retain them in any position in which they may be placed; so also a wire passing through the rump-bone into the body, will enable the stuffer to elevate the tail in any required direction.

It remains now only to arrange the feathers properly, and this, as well as putting the bird itself into its attitude, must be done while the skin is soft and pliable. Wherever the feathers are rough, they must be laid smooth with a needle and then bound with a fillet or bandage of paper or linen fastened on with a pin. The feathers of the wings and tail expanded by a narrow slip of card being placed above the feathers, and another piece below, expand the feathers carefully between them, and then fasten the two pieces of card together, with three or four pins thrust through them. If a crest be required on the head, as in the peacock, or the feathers of the neck ruffled, as if in anger, it is only requisite to brush the feathers back with the fingers for a day or two. The operation is now wholly complete, the specimen requiring nothing more than to be dried; this should be done by a draught of air. After three or four days the various fillets of paper and card may be removed, and the whole will retain the exact position which may have been given it. We will conclude this long article with a few remarks on the subject, taken from various sources.

Attitude of Birds.—If we wish the attitude of seizing on its prey, make the legs almost stretched, the claws extended, the head and neck bent down, the wings very much raised, about three-quarters open, and convex above, the tail forming a fan, almost perpendicular, and the body inclined towards the prey.

If we wish the bird flying, extend its wings as much as possible, the tail will be horizontal and open, the neck forward and a little on one side, the claws shut, and the feet pressed against the breast. Suspend it thus from the ceiling.

If we prefer the moment of surprise, the perch must be made obliquely, the left foot extended, the right on the contrary, very near the body and bent, the body thrown to the right, the wing of that side elevated and very much spread, the other less so and lower, the tail lowered, open and roofed—that is, sloped on each side, the neck raised and inclined to the right, the head leaning down, the beak open, and the eyes fixed on the object of its fear. This description may be applied to all birds of prey, and an infinity of others.

Vultures.—The king of the vultures is distinguished by the wrinkles on the naked part of the head, and the caruncle, or piece of flesh, on the base of the beak; the skin of these parts is red and bright blue, and the skin of the neck of a beautiful orange color. All these colors disappear on the death of the bird. They may be restored by mixing the colors on a pallet, and painting the parts when perfectly dry.

Climbing Birds.—The tail of these must always touch the upright stem at the extremity, and in mounting are to be placed upon an upright support.

Gallinaceæ.—The fleshy parts of the heads of cocks, &c., must be painted as described for vultures.

Flamingo.—This is one of the birds the head of which is too large to pass into the neck. When we meet with obstacles of this nature, we bare the neck as high as possible, then cut off the neck and bring the skin back again. To take away the remainder of the vertebræ and brain, make an incision behind the head, and remove the eyes by the same opening. This being done, sew up this cut with very close stitches.

Web-footed Birds.—In these fowls we must take care to spread the toes, and fix them to the stand with very small nails.

Ducks must have the body nearly perpendicular, and the necks in the shape of the letter S. Their heads are too large to pass through the neck.

Guillemots, Puffins, Peguins, &c.—These birds ought to have the neck, body, and feet, almost perpendicular. We must be very careful in skinning them, for their skin is very often furnished with a layer of fat or grease which easily spreads.

PHOTOGENIC DRAWINGS.

Mr. Robert Mallet has communicated to the Royal Irish Academy a notice of the discovery of the property of the light emitted by incandescent coke to blacken the photogenic paper; and proposed it as a substitute for solar light, or that from the oxy-hydrogen blowpipe with lime. One of the most important applications of the photogenic process, as yet suggested, is its adaptation to the self-registering of long-continued instrumental observations. Unless, however, an artificial light, of a simple and not expensive character, can be found to supply the place of solar light at night, the utility of this application will be much limited. Few artificial lights emit enough of the chemical rays to act with certainty on the prepared paper; while those which are known to act well, as the oxy-hydrogen lime light, are expensive, and difficult to manage. A considerable time since, the author discovered that the light emitted by incandescent coke, at the "Twyer" (or aperture by which the blast is admitted) of a cupola or furnace for melting cast iron, contained the chemical rays in abundance; and on lately trying the effect of this light on prepared paper, he found it was intensely blackened in about 45 seconds. In the single experiment made, the heat, which was considerable, was not separated from the light; but the author proposed to make further experiments, in which this precaution will be attended to. There is no difficulty to be apprehended in contriving an apparatus to burn a small quantity of coke at a high temperature. A diagram of an apparatus for this purpose was shown.

At a meeting of the Society for the Encouragement of the Useful Arts, held at the Royal Hotel, Princess-street, Edinburgh, Dr. Fyfe described a process for obtaining photogenic drawings requiring no correction of the shadow, or having the lights and shadows untransposed. The paper is first saturated with phosphate of silver, instead of nitrate. When a drawing is required, this phosphate paper is immersed in a solution of the *iodide of potass*, and while still moist exposed to the light, with the object, the impression of which is to be taken, placed on it, and left till the whole of the paper exposed becomes yellow, and when removed it exhibits a distinct representation of the object. In this process there is a tendency of the iodide to convert the dark phosphate to yellow iodide of silver, which it does instantly when the solution is strong, but very slowly when it is weak, unless it is exposed to light, and then the action goes on rapidly. It was observing this that induced Dr. Fyfe to try the

influence of light on phosphate paper besmeared with iodide of potass, by which he was led to the discovery. Of course when an object which allows the light to pass through it differently is put on the paper, those parts on which the denser portions of the object are placed still retain their darker color, the outer parts are tinged, just according to the transmission of the light. When impressions thus prepared are kept, they gradually begin to fade, owing to the continued action of the iodide of potass, and hence the necessity of submitting them to a preservative process. After numerous trials, that which seemed to answer best was merely immersing them in water for a few minutes, and in some cases, even allowing a stream of water to flow gently on them, so as to wash out the whole of the iodide of potassium not acted on—in this way the agent which tends to discolor the blackened phosphate seems to be removed.

ACTION OF VEGETABLE SUBSTANCES, GUM, SUGAR, &c., IN CONTACT WITH METALLIC OXIDES.

M. Becquerel, for a considerable period, directed his attention to the means of submitting organic substances to the action of electric currents, with the view of ascertaining the causes of some of the phenomena observable in those substances, particularly that of fermentation. It was already known, from the experiments of Cruikshank and Daniell, that on exposing a solution of sugar and lime in water to the action of the atmosphere, small crystals of carbonated lime are produced on the surface; but the cause of this phenomenon was entirely unknown, although it was supposed that the carbonic acid might perhaps be supplied by the atmosphere. M. Becquerel, however, has by means of the following experiment, ascertained the real source of the acid. He plunged into a wide-mouthed bottle, filled with barytes water, two tubes, (the lower parts of which were stopped with moistened barytes,) filled, the one with a solution of lime and sugar, and the other with a solution of sulphate of copper. The liquid contained in the first tube was connected with the positive pole of a voltaic pile, by means of a plate of platina, and that in the second tube with the negative pole, by means of a plate of copper. The moment this communication was established, the sulphate of copper was observed to be decomposed, the copper was precipitated in a metallic state on the copper plate, the sulphuric acid was absorbed by the barytes, and the oxygen was transported to the positive pole; where, by a re-action on the carbon of the sugar, it produced carbonic acid, which was immediately combined with the lime. After the lapse of some days, small prismatic crystals of carbonate of lime were observed on the plate of platina, and continued to increase as long as there remained any lime in the solution. Gum, the component parts of which are nearly similar to those of sugar, produced the same effect. In both cases, those portions of the vegetable substance which do not tend to the production of the carbonic acid, or of the water of crystallization of the carbonate, are converted into acetic acid. M. Becquerel was next led to examine the simultaneous action of saccharine and mucilaginous substances upon the metallic oxides, through the medium of the alkalies and the earths. If hydrate of copper be acted on by water and lime, with the aid of heat, it becomes black, and probably passes into an andydrous state; but if a very small quantity of sugar be added, a portion of the oxide is dissolved, and the liquid assumes a beautiful blue tint, similar to that of a solution of oxide of copper in ammoniac. Honey and sugar of milk have the same properties, which, however, have never been observed, except in saccharine substances. Potash and soda may be substituted for lime in this experiment with a similar effect, except that their faculty of dissolving is greater, whereas that of barytes and strontia is much less. Gum does not produce the same effect as sugar; that substance when dissolved by water, is not precipitated by the alkalies and earths which we have just mentioned, but if a deutoxide of copper, in a state of hydrate, be added, a flaky insoluble precipitate of gum and oxide of copper is formed. When there exists in the solution a small quantity of saccharine matter in addition, it reacts immediately on the excess of oxide, and of copper, which has been added, dissolves it, and gives a blue color to the solution. In order, therefore, to detect the existence of gum and saccharine matter in any substance which contains both, it is sufficient to add potash and caustic lime to the solution, and then apply hydrate of copper to it. The mucilage found in a decoction of linseed produces the same effect as gum; and as the solution becomes slightly tinged with blue, it is evident that it contains saccharine matter. If the solution be acted on by heat, the effects are different. If a solution of sugar, potash, and deutoxide of copper, in water, be heated to the boiling temperature, the blue color changes successively to green, yellow, orange, and finally to red, and then all the deutoxide is changed into protoxide. If oxide of copper be then added gradually, until there is no longer any protoxide formed, all the sugar is decomposed, and nothing remains in the solution but carbonate of potash and a small quantity of acetate of the same base.

The saccharine matter of milk, which, when cold, acts on copper and potash in the same manner as common sugar, acts differently when heated. The deutoxide of copper passes first to a state of protoxide, and is then reduced to a metallic state. The oxides of gold, silver, and platina, submitted to the same tests as the oxide of copper, are reduced to a metallic state, while the oxides of iron, zinc, and cobalt do not undergo any change. The deutoxide of mercury is reduced to a metallic state by potash and the saccharine matter of milk; it then, in consequence of the water which is interposed between the parts, presents itself under the form of paste. Under this form, the mercury may be applied to glass without the necessity of using tin-foil; it is sufficient to spread the paste in a very thin layer, and heat the glass slightly, to remove the water which is interposed. Lime, barytes, and strontia, when acting by means of heat on the deutoxide of copper and saccharine matter, do not form compositions similar to those of the alkalies. Lime, for instance, does not convert the deutoxide into a protoxide, or a metallic state; it occasions a precipitate of an orange-yellow color, formed of the protoxide of copper and lime. In the same manner, proto-cuprates of barytes and strontia are precipitated.

These are the principal results of M. Becquerel's experiments, which have considerable importance, as showing the intimate connection between the electric and chemical systems.

REVIEW.

A Course of Eight Lectures on Electricity, Galvanism, Magnetism, and Electro-Magnetism. By Henry M. Noad. London: Scott, Webster, and Co., p. 382.

No one of the physical sciences, with perhaps the exception of chemistry, has been of late years so much studied as electricity, considering that term in its widest interpretation, as including magnetism, &c., and yet strange as it must appear, upon no one science whatever have their been so few books published. The last age had Cavallo, Adams, Singer, and numberless other writers; but for the wonderful discoveries of our own day no chronicler appeared; we therefore hailed with delight the announcement of these lectures, and hastened to procure a copy, anxiously hoping to find hundreds of new and delightful experiments, calculated to convince the philosopher by their truth and importance, and to enchant the amateur by their brilliancy and variety.

In this we were at first somewhat disappointed, until looking at the preface, we find that the primary object and aim of the author has been "to show in as interesting, concise, and clear a manner as possible, the identity of the electricity derived from different sources, and that the work does not pretend to a scientific character, or to convey original information." As such, therefore, we must regard it, and not expect more from the author than his plan proposed, but rather see if he has accomplished well his object, and this we are bound to confess is the case. Priestly's "History of Electricity" gave an account of the science during its infancy; the present work continues it till now, showing the progress of discovery and research under the hands of Biot, Faraday, Davy, De Luc, Daniell, Mullins, Barlow, Brewster, Ritchie, Wheatstone, and others, and recording just so many experiments as are necessary to explain the subject, and no logical reasoning or mathematical demonstration. The absence of these therefore prevents the work being scientific, while the paucity of experiments, and still greater neglect of apparatus, (there being but very few instruments described,) prevent it being so popular and useful as it might have been made; yet as a history of the science it is to be recommended, and the more so as it comprises in a small compass, that valuable matter hitherto scattered over a wide extent of literature. We give the following extract as being among the best in the book:—

"*The Discovery of the Mariner's Compass.*—A Neapolitan, named Flavio Gioia, who lived in the thirteenth century, has been regarded by many as the inventor of the compass. Dr. Gilbert affirms that Paulus Venetus brought the compass from China to Italy in 1260; and Ludi Vestomannus asserts, that about 1500, he saw a pilot in the East Indies direct his course by a magnetic needle like those now in use. The variation of the needle was discovered two hundred years ago, before the time of Columbus, but the *variation of the variation*, that is, the fact that variation was not a constant quantity, but varied in different latitudes, was first discovered by the discoverer of America, as appears from the following extract from 'Irving's Life and Voyages of Columbus,' vol. 1, p. 201. 'On the 23rd of September, 1492, he perceived about nightfall, that the needle, instead of pointing to the north star varied but half a point, or between five and six degrees, to the north-west, and still more on the following morning. Struck with this circumstance, he observed it attentively for three days, and found that the variation increased as he advanced. He at first made no mention of this phenomenon, knowing how ready his people were to take alarm; but it soon attracted the attention of the pilots, and filled them with consternation. It seemed as if the laws of nature were changing as they advanced, and that they were entering into another world, subject to unknown influences. They apprehended that the compass was about to lose its mysterious virtues; and without this guide what was to become of them in a vast and trackless ocean. Columbus tasked his science and ingenuity for reasons with which to allay their terrors. He told them that the direction of the needle was not to the polar star, but to some fixed and invisible point. The variation was not caused by any failing in the compass, which like the other heavenly bodies had its changes and revolutions, and every day described a circle round the pole. The high opinion that the pilots entertained of Columbus, as a profound astronomer, gave weight to his theory, and their alarm subsided.'"

MISCELLANIES.

Optical Deceptions.—If two equal cog wheels be cut out of card-board, placed upon a pin, and whirled round with equal velocity in opposite directions, instead of producing a hazy tint, as one wheel would do, or even as the two would, if revolving in the same direction, there is presented an extraordinary appearance of a fixed wheel. Again, if one wheel move somewhat faster than the other, then the spectral wheel appears to move slowly round, if the cogs be cut slantwise on both wheels, the spectral wheel in like manner exhibits slant cogs; but if one of the wheels be turned, so that the cogs shall point in opposite directions, then the spectral wheel has straight cogs. If wheels with radii, or arms, be viewed when moving, then similar optical deceptions appear; and though the wheels move never so fast, yet the magic of a fixed wheel will be presented, provided they move with equal velocities. If they overlap each other, even in a small degree, then very curious lines will be seen. Mr. Faraday avails himself of a magic lanthorn for the purpose of showing a series of deceptions as produced by shadows. Thus, with the two wheels mentioned, if only one is turned in the sunlight, a shadow corresponding to its appearance will be produced; but if both are turned in opposite directions the shadow is no longer uniform, but has light and dark alternately, and resembles the shadow of a *fixed* wheel. Perhaps the most striking experiment is the following:—A paste-board wheel has a certain number of teeth, or cogs at its edge—a little nearer the centre is a series of apertures, resembling the cogs in arrangement, but not to the same number. Still nearer the centre is another series of the same apertures, different in number, and varying from the former. When this wheel is fixed upon another, with its face held two or three yards from an illuminated mirror, and spun round, the cogs disappear, and a greyish belt, three inches broad, becomes visible; but on looking at the glass, through the moving wheel, appearances entirely change—one row of cogs, or apertures, appears as fixed as if the wheel were not moving, while the other two give an opposite result; shifting the eye a little, other and new appearances were produced. Mr. F. states, that the combinations, as to color, form, and other circumstances, are innumerable.

The Phenakisticope or *Stoboscope*—This amusing instrument consists of a turning wheel upon which figures are seen to walk, jump, pump water, &c. The disk or wheel should be of stout card-board, upon which should be painted, towards the edge, figures in eight or ten postures. Thus if it is wished to represent a man bowing, the first position is a man standing upright; in the second, his body has a slight inclination; in the third, still more; and so on to the sixth position, where the body is most bent; the four following represent the body returning gradually to its erect posture. Between each of the figures, on the wheel, should be a slit, three-fourths of an inch long, and one-fourth of an inch wide, in a direction parallel with the radii of the wheel, and extending to an equal distance from the centre. To work this instrument, place the figured side of the wheel before a looking glass, and cause it to revolve upon its centre; then look through the slits or apertures, and you may observe, in the glass, the figures bowing continually, and with a rapidity proportioned to the rate at which the wheel turns; the illusion depends on the circumstance, that the wheel between each aperture is covered, while the figure goes further; that the deception may be complete, it is necessary that every part of the figures not bowing should be at an equal distance from the centre of the wheel and from the slits; also, that the figure possess equal thickness and color.

ANSWERS TO QUERIES.

25—*How are fossil woods cut and ground, so as to be fit microscopic objects?* Answered on page 56.

26—*Where can fossil animalcules be purchased?* Of Mr. Samuels, Fleet Street; of Mr. Stutchbury, Theobald's Road, and of most opticians.

27—*Why does rotten wood shine in the dark?* Some have supposed that a peculiar kind of fermentation takes place in certain kinds of wood, decaying fruit, &c., which gives rise to phosphuretted hydrogen. Others think that the putrescence of these bodies give life to minute luminous insects.

33 and 34—*Whence arises the singing of a tea-kettle?—And what occasions the rumbling noise when hot iron is plunged into cold water, or steam let into a cold vessel?* In the first case, when a piece of hot metal is plunged into water, the surface of water in contact with it is instantly converted into steam, and by its sudden expansion into a much greater volume, like gunpowder when ignited, causes a violent vibration, which is greater as the metal is hotter. In the case where steam is let into a cold vessel, the phenomenon is reversed, for, on the entrance of the steam, part of the air is driven out to make way for it, but the next instant the steam being rapidly condensed, a vacuum is produced, which the air rushing in to fill up produces the noise referred to. The singing of a tea-kettle has a very similar origin. The water as it becomes hot rarifies the air above it, which, in its escape, passing through the small cavity around the lid, produces the noise referred to.

38—*What is the cause of magnetism?* To inquire into the cause of the great forces of nature, such as magnetism and many others, must lead to imperfect conclusions, as we know them only by their effects. Thus the cause of gravitation is hidden from us, though its effects are well known. Thus it is with the attraction of cohesion. Magnetism is supposed to be caused by the electric fluid, which passing in one direction occasions magnetic currents in another, but whether this fluid causes another fluid to be formed, or merely becomes perceptible to us, is unknown.

39—*Why is the rainbow a ring, and not a circular disc?* The reason is, that the rays of light passing through the drops of water only reach the eye of the observer, within a certain angle: that is, there is a limit on either side of the bow, beyond which the observer does not see the different rays refracted.

44—*What is the best mode of killing insects intended for specimens?* Pierce the thorax with a pin, and put the insect thus fastened to a cork, in a wine glass, with a burning sulphur match, or else put upon it a drop of prussic acid.

45—*Does alcohol exist in any living vegetable?* No. Alcohol is not the product of vitality; it can only be generated by fermenting those vegetables which contain saccharine matter; but be it observed, that certain juicy fruits may undergo the vinous fermentation, even when hanging on the tree, and hence become intoxicating; but this does not annul the fact of alcohol being the result of decomposition, because fruit when fully ripe, is no longer a part of the living plant, but merely continued attached to it. Grapes in warm countries are on the vines till *dead ripe*, though we very much doubt if the stories of the ancients usually getting drunk by eating grapes be at all to be depended upon: the bunches of grapes put into the hands of bacchanals being merely significant of wine, the product of the grape.

46 and 48—See answer to Query 38.

49—*What is the reason that the gold leaf, through which the electrical shock is passed, becomes embedded in the glass between which it is placed?* Because the surface of the glass and the gold leaf are, by the shock, partially melted at the same moment, and therefore they cohere.

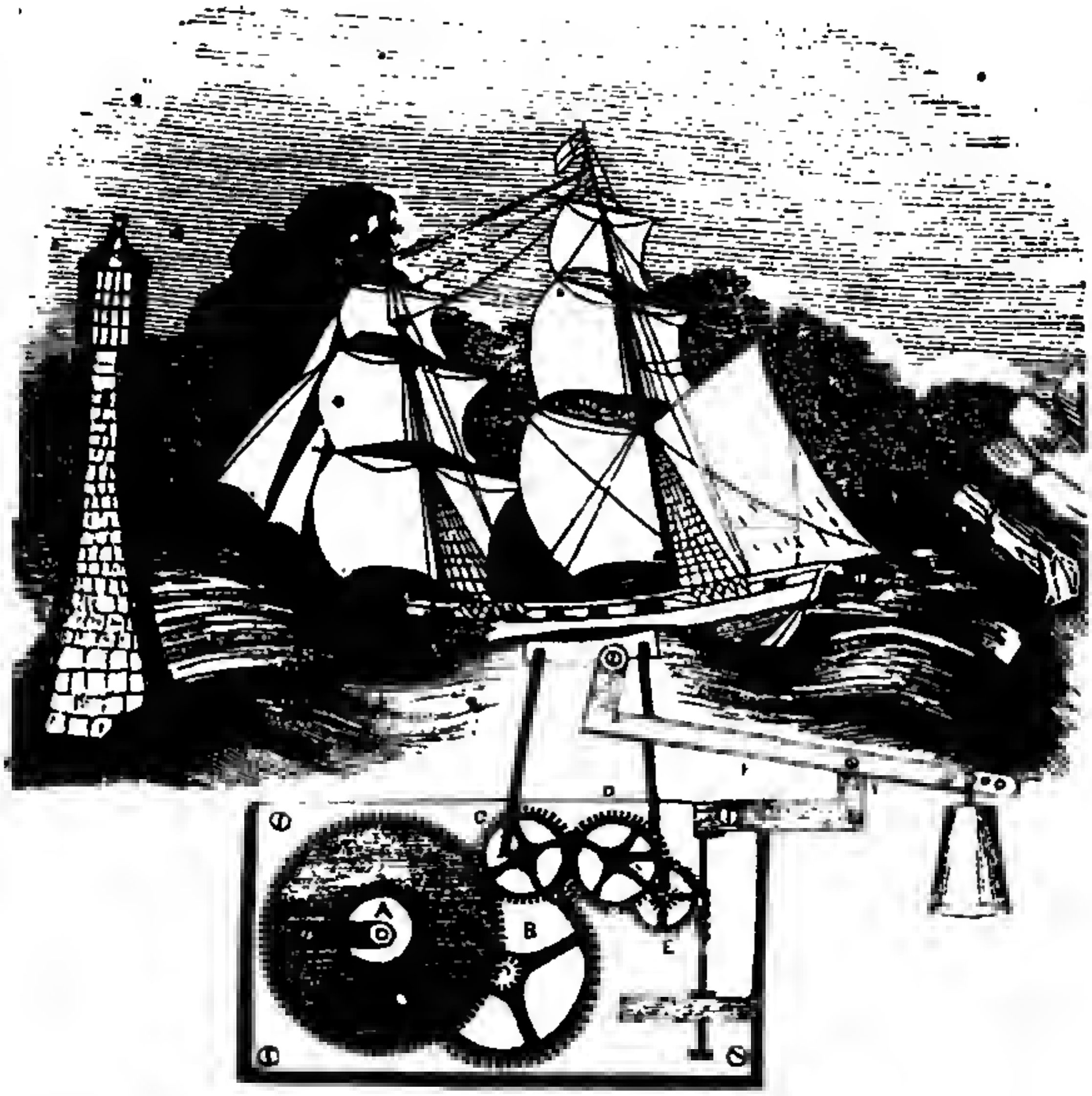
50—*By photogenic drawing can any of the primitive colors be produced?* Not any, except the violet. The only colors produced are various shades of violet, brown, and black.

51—*What is the composition of the marmoratum cement as used by dentists?* Mastic varnish and plaster of Paris. (*See page* 360.)

52—*Where are the clouds when the air is clear?* Clouds are masses of vapor, more or less dense according to circumstances, floating near the surface ready to fall, in rain, snow, &c., as soon as the air by any cause renders them a little more dense, or else rising higher whenever a change of temperature renders them more buoyant, until they exist not in the state of condensed masses, but of vapor diffused all around.

53—*Why does the wind come in gusts?* When any portion of the atmosphere is heated, consequently rendered light, it becomes displaced by that part which is more dense, and *vice versa*. Various modifications of these causes, produce the different kinds of wind, which, when attended with a rapid action of short duration, are denominated gusts of wind.

54—*Can Fishes be said to breathe?* Yes. They respire by means of branchiæ, which are internal in the adult, and are often preceded by external branchiæ in the young. The lungs are always rudimentary, sometimes in the form of a short, single air bag, sometimes divided or ramified, and generally communicating by an air duct with the intestine, stomach, and œsophagus, but seldom aiding in respiration. The quantity of air consumed by fishes is very small, which enables them to remain under water a considerable time without respiring.



THE AUTOMATON SHIP AND SEA.

There have been lately exhibited in London, in various of the clockmakers' and jewellers' shops, models of ships put in action by annexed machinery, and having the various rolling and pitching motions which naturally occur with real vessels. It is one of the most successful attempts at imitative motion ever accomplished. It is perfectly free from all those *staccato* effects which generally mar the finest productions of clock-work, and it faithfully exhibits the easy, ever-varying, and ever-blending changes of position and surface, which a steady stiff breeze will produce on a flowing sea, and a vessel under full sail.

The sympathy, if we may so term it, of the ship with the sea, is admirable; when she seems to overtake a wave, her bow slides up its side, and is projected into the air; as she rides on its breast, her stern also becomes elevated, and her deck is, for an instant, horizontal; and then, as she leaves it, her bow is depressed, and she sinks bodily down into the succeeding hollow.

Though the effects are so perfect, yet the mechanism, it will be evident, is very simple. It is concealed in the model from the observer, by a membrane, which is attached to the hull, and thence extending to the borders of the machinery-chest, is there fastened. This membrane is very delicate in its texture, and extremely pliant; it is not strained tight, but, on the contrary, left very full; and its surface is painted to represent an agitated sea. In all the elevations and depressions of the vessel, this membrane of course accompanies it; but to the spectator, the motions of the vessel seem to be the effect and not the cause of the waves.

In the diagram, one of the containing plates of the machinery is removed to show the connexion of the parts. A spring contained in a barrel A communicates motion to the wheel B, by means of the pinion in the centre of it; this works the wheel C, which is connected with and turns the wheel D; the wheels C and D having the same number of teeth. The force is continued onward to the scapement wheel F, which, working into an endless screw attached to a fly, serves the purpose of equalizing the movement, preventing the machinery *suddenly running down;* it answers, however, no object in communicating either of the motions of the vessel itself. This is accomplished by means of levers attached to cranks working from the centres of the wheels C and D; the other end of those levers being attached to the side of the vessel at two points, as represented underneath the membrane. Also to the same part, or still better to the keel, is attached the bent lever F, resting on a fulcrum I, which is continued beyond to any convenient length, and has near its end a moveable wheel attached.

Supposing the lever F to be removed, the cranks and the levers vertical, and the machinery in action, it will be seen by examination, that motion would be communicated to the vessel, but that it would be simply vertical, a mere up and down movement, and that the deck would be always parallel to the line in which it lay at starting; if we add the lever F, centering it midway between the points where the levers from the wheels are fastened to the side of the vessel, a very small but scarcely perceptible variation would be produced, but if we now place its centre-pin nearer to the centre-pin of one of the shafts than to that of the other, we shall have the motion of the two levers so controlled by the lever F, that they move both ascending and descending, with different and differing velocities; so that the stem and the stern of the ship will rarely remain for two successive instants in the same level plane.

The invention is French, and patented. The names of T. C. Cailly and Eude, are stamped upon the machinery case.

THE CLOCK PENDULUM.

It is controverted by Galileo and Huygens which of the two first applied the pendulum to a clock.

After Huygens had discovered that the vibration made in arcs of a cycloid, however unequal they might be in extent, were all equal in time, he soon perceived that a pendulum applied to a clock, so as to make it describe arcs of a cycloid, would rectify the otherwise unavoidable irregularities of the motion of the clock; since, though the several causes of these irregularities should occasion the pendulum to make greater or smaller vibrations, yet, by virtue of the cycloid, it would still make them perfectly equal in point of time: and the motion of the clock governed by it would, therefore, be preserved in equal regularity. But the difficulty was, how to make the pendulum describe arcs of a cycloid; for naturally the pendulum, being tied to a fixed point, can only describe regular arcs about it.

Here Huygens contrived to fix the iron rod or wire, which bears the ball or weight at the top, to a silken thread, placed between two cycloidal cheeks, or two little arcs of a cycloid, made of metal.

Hence the motion of vibration, applying successively from one of those arcs to the other, the thread, which is extremely flexible, easily assumes the figures of them, and by that means causes the ball or weight at the bottom to describe a just cycloidal arc.

This is, doubtless, one of the most ingenious and useful inventions many ages have produced, by means of which it has been asserted, that there have been clocks which would not vary a single second in several days; and the same invention also, gave rise to the whole doctrine of involute and evolute curves, with the radius and degree of curvature, &c.

It is true the pendulum is still liable to its irregularities, how minute soever they may be. The silken thread by which it is suspended shortens in moist weather, and lengthens in dry, by which means the length of the whole pendulum, and consequently the times of the vibrations, are somewhat varied.

To obviate this inconvenience, M. de la Hire, instead of a silken thread, used a fine spring, which was not indeed subject to shorten or lengthen from those causes; yet he found it grew stiffer in cold weather, and then made its vibrations faster than in warm, to which also we may add its expansion and contraction by heat and cold. He, therefore, had recourse to a stiff wire or rod, from one end to the other. Indeed by this substitute he renounced the advantages of the cycloid; but he found, as he says, by experience, the vibrations in circular arcs are performed in times as equal, provided they are not of too great extent, as those in cycloids; but the experiments of Sir Jonas Moore, and others, have demonstrated the contrary.

The ordinary causes of the irregularities of pendulums; Dr. Durham ascribes to the alterations in the gravity and temperature of the air, which increase and diminish the weight of the ball, and by those means make the vibration greater and less; an accession of weight in the ball being found by experiment to accelerate the motion of the pendulum, for a weight of six pounds added to the ball, Dr. Durham found, made his clock gain three seconds every day.

A general remedy against the inconveniences of pendulums is to make them long, the ball heavy, and to vibrate but in small arcs. These are the usual means employed in England; the cycloidal cheeks being generally neglected.

Pendulum clocks, resting against the same rail, have been found to influence each other's motion.

ANIMAL HEAT

The natural temperature of man is so constant and equable, that a thermometer bulb being placed under the tongue, the mercury will be found to stand at nearly the same degree (96°) in the hottest climate, as at the poles. This heat is very little dependent upon external circumstances, and the investigation of its origin is worthy the attention of the scientific. For the first consistent theory of the production of animal heat we are indebted to Dr. Crawford. He considered that arterial blood has a greater capacity for heat than venous blood, and common air than carbonic acid gas. To make his theory intelligible, I should premise that the circulation of the blood is performed in

the following manner:—The blood is propelled from the heart into the arteries—it is distributed throughout the body and returns again to the heart through the veins: in respiration a remarkable change takes place through the medium of the air in the lungs; the black venous blood being exposed to the air is converted into florid arterial blood; a certain proportion of oxygen is withdrawn from the air, and a corresponding volume of carbonic acid gas eliminated; such is the process of the circulation and *sanguification* of the blood, and on this was Crawford's theory founded. When the carbon of the venous blood unites with the inspired oxygen, and forms carbonic acid, the less capacity of this than common air for caloric, must cause an increase of temperature; but the blood, having changed from venous to arterial, has acquired a greater capacity than before, and absorbs the heat given out by the carbonic acid. The blood, of course, does not become warmer; because the amount of heat is no more than enough to render its temperature equal to what it was before. The body in this way acquires a fund of caloric, and yet the lungs, the laboratory in which it is acquired, do not experience any elevation of temperature.

Another and very different hypothesis has been advanced by that illustrious physiologist, Sir Benjamin Brodie. He refers the generation of animal heat solely to the nervous system. He divided the spinal marrow of many of the inferior animals, and at the same time kept up respiration by artificial means; but though the sanguification of the blood was effected, though carbonic acid was duly eliminated, the temperature of the animals rapidly fell. He therefore concludes, that animal heat depends much more upon the influence of the nerves, than any chemical changes occurring in respiration.

Such are the most plausible theories yet advanced to account for the subject under our notice; let me now examine their comparative merits. The hypothesis of Crawford is untenable in its full extent, for recent investigations have shown that there is *no difference*, in capacity for heat, between venous and arterial blood; consequently the corner-stone of this theory is shaken. Again, the experiments of Brodie are not beyond cavil, for other physiologists assert, that animal heat may be maintained for some time by the aid of artificial respiration, even when all connection has ceased between the brain and lungs. Such is the position in which the matter at present rests; there is a vital and chemical hypothesis. I am inclined to think that a modification of Crawford's views may be adopted with much plausibility; it is going too far to say, that the arterialization of the blood has nothing to do with the maintenance of the vital temperature—one of the great functions performed by respiration is the evolution of much carbonic acid from the system; now we know, that the disengagement of carbonic acid is often, or I may say always, accompanied by evolution of caloric—such as in combustion and fermentation, and to say the least of it, there is a remarkable parallelism between combustion and respiration. Warm-blooded animals are observed to consume the most oxygen, and in proportion as their respiration is perfect, are they found to possess the most animal heat. Thus reptiles and fishes are very little warmer than the elements they inhabit.

W. PRESTON.

[Our correspondent is, perhaps, not aware of the recently-promulgated theory of Dr. J. M. Winn, (see Philosophical Magazine, March, 1839,) who has gone far to prove that the incessant contractions and dilatations of the arteries during life must prove an efficient source of animal heat. The Dr. was led to this inference by having observed that caoutchouc has the property of evolving heat when suddenly stretched. To prove the accuracy of his supposition, that other bodies might be endowed with a similar property, he took the aorta of a bullock, and was gratified in being enabled to verify his previous conjecture. The experiment he describes as follows:—"Having cut off a circular portion of the descending arc of the aorta, about an inch in length, I laid it open, and carefully dissected out the elastic coat, and taking hold of it by each extremity I pulled it to and fro with a continuous jirking motion, (in imitation of the systole and diastole of the artery,) for the space of about a minute. When, placing it upon the bulb of a thermometer, I had the satisfaction to find that after it had remained two minutes, the mercury had risen as many degrees. On removing the thermometer, the heat immediately began to diminish." The Dr. took every precaution to prevent the heat arising from his hand, breath, &c., and concludes that the *whole* of the heat developed in the animal economy can, by this theory, be satisfactorily explained, and also that the variations of animal temperature, arising from topical inflammations, exercise, the chemical functions of the viscera, febrile disorders, and decrease of animal heat in old age, can be more readily accounted for by this mechanical theory, than by either that of Dr. Crawford, or Sir B. Brodie.—ED.]

NATURE OF PETRIFACTION.

In many instances we find a mere substitution of mineral matter for the original animal or vegetable substance. Such are those casts of sandstone, indurated clay, and other consolidated materials, which bear the forms and impressions of organic bodies, but possess neither the internal structure, nor any vestige of the constituent substances of the original. Casts and impressions of shells, of the stems and leaves of plants, and of fish-scales; the flints, which derive their form from echinites, &c., are familiar examples of this process.

In genuine petrifactions a transmutation of the parts of an organized body into mineral matter takes place. Patrin, Brongniart, and other philosophers, suppose that petrifaction has frequently been effected suddenly, by the combination of gaseous fluids with the constituent principles of organic structure. It appears, indeed, certain, that the conversion into silex both of animal and vegetable substances, must, in the majority of instances have been almost instantaneous, for the most delicate parts, those which would undergo decomposition with great rapidity are often preserved; such, for instance, as the capsule of the eye, the membranes of the stomach, the soft bodies of molusca; and in plants, the cellular and vascular tissue, and even the pollen. The fact of the silicification of trees in loose sand, and of the bodies of molusca in their shells, as in the fossil oysters from Brighton, while neither the sand in the one instance, nor the shells in the other, are impregnated with silex, cannot be explained by the infiltration of a siliceous fluid into cavities left by the decomposition and removal of the animal

substance. A combination of gaseous fluids, with the constituent principles of the animal or vegetable, changing the latter into stone, without modifying the arrangement of their molecules, so as to alter forms, seems the only mode by which such a transmutation can have been effected. The production of congelation, by a simple abstraction of caloric, is akin to this change; but petrifaction is induced by the introduction of another principle. As to density, the most subtle gaseous fluids may acquire the greatest solidity; as, for example, in the union of oxygen with metallic substances. Oxygen is supposed by Patrin to be a chief agent in the phenomenon of petrifaction, by its combination with the phosphoric principle, which is present in organized bodies.

Artificial Petrifactions.—Last year M. Goppert published the result of an interesting investigation of the condition of fossil plants, and the process of petrifaction. Mr. Parkinson had remarked, that the leaf in ironstone modules might sometimes be separated in the form of a carbonaceous film; and M. Goppert having lately found similar examples, was induced to undertake a set of experiments. He placed fern leaves in clay, dried them in the shade, exposed them to a red heat, and obtained striking resemblances to fossil plants. According to the degree of heat, the plant was found either brown, shining black, or entirely lost, the impression only remaining; but in the latter case the surrounding clay was stained black, thus indicating that the color of the coal shales is from the carbon derived from the plants they include. Plants soaked in a solution of sulphate of iron were dried and heated till every trace of organic matter had disappeared, and the oxyde was found to present the form of the plant. In a slice of pine-tree the punctured vessels peculiar to this family of vegetables were perceptible. These results by heat are probably produced naturally, by the action of moisture under great pressure, and the influence of a high temperature.

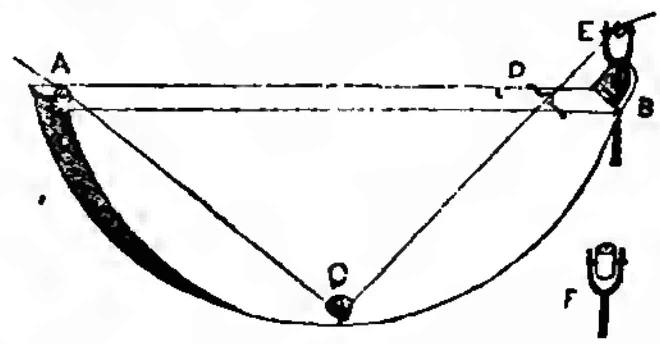
Fossilization of Wood. — Sometimes the most minute structure is preserved, as in the vessels of palms and coniferæ, which are as distinct in the fossil as in the recent trees. From this state of perfection, we have every degree of change, to the last stage of decay; the condition of the wood, therefore, had no influence on the process. The hardest wood, and the most tender and succulent, as for instance, the young leaves of the palm, are alike silicified. In some instances, the cellular tissue has been petrified, and the vessels have disappeared; here silicification must have taken place soon after the wood was exposed to the action of moisture, because the cellular structure would soon decay; the process was then suspended, and the vessels decomposed. In other examples, the vessels alone remain; a proof that petrifaction did not commence till the cellular tissue was destroyed. The specimens where both cells and vessels are silicified, show that the process began at an early period, and continued till the whole vegetable structure was transmuted into stone. Dr. Turner, in some admirable comments on the subject of petrifaction, remarks, that whenever the decomposition of an organic body has begun, the elements into which it is resolved are in a condition peculiarly favorable to their entering into new combinations; and that if water, charged with animal matter, come in contact with bodies in this state, a mutual action takes place, new combinations result, and solid particles are precipitated, so as to occupy the place left vacant by the decomposed organic matter.

Mr. Parkinson, in corroboration of his opinion that wood undergoes bituminization before it becomes petrified, mentions, that a specimen of wood from Walton, which was changed into marble, and took a beautiful polish, left, upon removing the carbonate of lime by muriatic acid, a mass of light, inflammable, bituminous wood, which possessed a volume almost equal to its original state.

Petrifaction by Flint.—The various forms in which silex is found, are proved to have been dependant on its state of solution; in quartz crystals it was entirely dissolved, in agate and chalcedony it was in a gelatinous state, assuming a spheroidal, or orbicular disposition, according to the motion given to its molecules. Its condition was also modified by the influence of organic matter. In some polished slices of flints from Bognor the transition from flint to agate, chalcedony, and crystallized quartz, is beautifully exhibited. The shell of an echinus, in the possession of Dr. Mantell, is transmuted into crystallized carbonate of lime, and the lower part of the cavity occupied by flint, the upper surface of the latter being covered by crystals of calcareous spar. The curious fact that the shells of the echinites in the chalk are almost invariably filled with flint, while the crustaceous covering is converted into calcareous spar, is, perhaps, attributable to the animal matter of the echinus having undergone silicification; for the most organized parts are those which appear to have been most susceptible of siliceous petrifaction. In another specimen in Dr. Mantell's museum, the body of an oyster is turned into flint, while the shell is, as usual, carbonate of lime. The shells of molusca, the crustaceous skeletons of echini, and the bones of the belemno-sepiæ, appear to have possessed too little animal matter, and to have been too much protected by calcareous earth, to have become silicified; they are changed into spar by water charged with carbonic acid gas, having insensibly effected the crystallization of their molecules.

MACHINE TO COVER WIRE WITH SEALING WAX.

Construct a vessel in the shape of a segment of a cylinder; let the distance, A B, (see fig.,) be



about fourteen inches, and the versed side, or depth, about five inches, the breadth two inches. At A is fixed a small deep grooved pulley, and at C is another, about one and a half inch in diameter, also deeply grooved: at D is soldered a stout wire, bent as in the figure. E is a small cylinder of brass, with a hole through it in the direction of its axis, a little larger than the size of the wire intended to be covered; the diameter of the aperture may vary according as we may wish to give

a thick or a thin covering to the wire. Several cylinders ought to be made of different bores, to accommodate wire of different sizes. The cylinders have small steel centres, as represented at F, which fit severally into a steel fork or spring. The bottom part of the steel spring fits into a tube at the end of B, where is a channel to convey back into the vessel the redundant resin. The cylinder E, therefore, having motion in every direction, can accommodate itself to the wire. It will, however, always be best to draw the wire from the wax in a line in which C and D coincide. Every thing being now arranged, the wire to be covered is passed over the pulley at A, under C, over D, and through the brass cylinder at E. The brass cylinder must be heated by means of a lamp, in order to prevent it solidifying the wax. The vessel is now to be partially filled with melted sealing wax or resin, and the wire must be drawn through at a pretty quick, though regular speed. The wax may be kept melted by a lamp placed underneath the vessel. If the wax get solid at E it must be melted by means of the lamp.

With an apparatus like this, 2500 feet of thin wire have been covered in half an hour.

The resin is made by mixing equal parts of shell lac and Venice turpentine, taking care to melt the turpentine before putting in the shell lac, which must be done gradually. If the wax should be found too brittle, it may be brought to a proper consistence by adding a little spirits of turpentine. A few trials will enable a person to judge of the right consistence of the wax.

Wire covered in this way is as valuable for electro-magnetic purposes, as if it were covered with silk or cotton.

PRINTING BY ELECTRICITY

The production of drawing by electricity is a subject which seems to have engaged more attention abroad than in this country. In Russia they have long been in the practice of engraving what are called Russian snuff-boxes, which are formed of a kind of imitation platinum, and have drawings made upon them by an application to their conducting powers. Recently, Professor Jacobi, of St. Petersburgh, has been encouraged by the Emperor in a course of experiments on copying copper-plates by galvanism. He uses a new compound metal, and transmits all the lines of the engraving with perfect accuracy.

The sympathy and antipathy of electricity to particular colors seem, however, to point out a means of more easily effecting the process of copying. It has long been known that electricity is repelled by a black surface, and attracted by white; and some interesting illustrations of the effects of a thunder-storm upon cattle are related in the "Philosophical Transactions." This effect has been further confirmed by an able article on the operation of lightning on the masts of men-of-war, read before the Electrical Society at one of their late meetings.

This property of color might be so applied, as, by electrical power, to produce engraved plates from prints, impressions of prints from plates or even from other prints, and an operation introduced which might, in some cases, compete with photograhy, and in others supersede the printing press.—*Railway Magazine.*

MELLONI'S EXPERIMENTS ON HEAT.

At the Royal Institution, on the 23rd of January, 1835, Dr. Faraday commenced the lectures of the season by describing and exhibiting the experiments which Melloni, a young Italian philosopher now resident at Paris, contrived to elucidate the nature of heat.

The great improvement which he has introduced, and which bids fair to enable us soon to develope completely the cause of the phenomenon dependent on the presence of this important principle, is the adaptation of the thermo-multiplier as a delicate indicator of sensible heat. All the experiments which had been previously made on this subject were performed by means of Leslie's differential thermometer, which, although comparatively, as to other instruments, a delicate contrivance, is surpassed in an infinite degree by the thermo-multiplier. The multiplier consists of about 30 pairs of bars of bismuth and antimony; the elements being so extremely delicately formed that the extremities present a surface of 4-10ths of an inch square. These are made to communicate with the multiplier, by means of wires leading from the extreme bars. The multiplier consists of a coil of silver wire, armed with silk, and having a magnetic needle so placed in a free space within the centre of the coil, as to enable it to oscillate readily. Now, it was observed by Melloni, that when heat, even that of the hand, is applied to the pile, a powerful effect is produced upon the needle of the multiplier, which undergoes an immediate declination, and traverses an arc more or less great if the heat is constant in a constant interval. It is quite obvious, therefore, that this must be a most excellent thermoscope, and must be admirably adapted to the delicacy which is necessary in experimenting in reference to heat. Provided, then, with this apparatus, Melloni set about examining accurately the relations of heat and light, a problem which philosophers have long been endeavouring to elucidate. For this purpose, he studied permeability of heat through different bodies. Mariotte concluded, from his experiments, that the heat of a common fire does not pass through glass, or at least, in very minute quantity. Scheele went further, and decided that not a ray of heat traversed glass. Pictet, however, repeated Scheele's experiment, and obtained a contrary result. From these observations, and those of Herschel, it was inferred that heat does not pass through diaphanous substances, with the exception of atmospheric air. Prevost and Delarouche, by ingenious adaptations, proved, however, that heat is transmitted directly through glass, independent of its conducting power; and this fact has been allowed, with few exceptions, by all philosophers. But although this admission was made, the subject was involved in great obscurity, and presented an inviting field of inquiry to the ingenuity of Melloni. No examination had been instituted into the influence of the state of the surface, of the thickness of the substances through which the heat was transmitted, or of their internal structure upon permeating heat. These, however, were taken up by Melloni, and he is still engaged in prosecuting his researches. It is easy to see how the different relative diathermal powers or capacities of bodies for transmitting heat could be determined by the apparatus of Melloni, for all that was required was to interpose the substance

whose powers were to be investigated, between a steady heat and the voltaic pile, when their capacities would be indicated by the rapidity of the action upon the needle. That the heat is actually transmitted, and does not pass by conduction, is proved by the fact that the interoal portions of the glass do not instantly become heated, which is demonstrated by placing a glass screen in front of the pile, and intercepting the communication with the source of heat. The posterior surface of the glass plate would radiate the heat conducted from its interior towards the pile, if the hypothesis that the heat is communicated by conduction were correct. But this does not occur, and hence, there is no alternative left but the conclusion that heat permeates bodies directly. Heat and light agree, therefore, in this property, that both possess the power of passing through bodies. It is proper that each should have such a capacity distinguished by appropriate names, until their identity be proved. Melloni terms the permeating power of heat through bodies, *diathermal* power, just as we indicate capacity of bodies to transmit light by the names, transparency, opalescence, &c. The diathermal power is subject to similar modifications. Heat, however, differs from light in this respect, that the facility with which it is transmitted by different bodies has no relation to their transparency.

Thus if we suppose the rays of a constant heat to be represented by 100, the only body which appears but slightly to diminish this when interposed as a screen is rock salt, whose diathermal power is 92, but the quantity of heat transmitted through a crystal of smoke-colored quartz will be denoted by 57, and through a crystal of alum by 12, where the difference is so very great as to excite astonishment. This and similar facts have induced Melloni to conclude that heat and light are distinct; but in this opinion Dr. Faraday does not coincide.

Melloni has also examined the diathermal relation of colors, and has found that their powers are in the following order: violet 53, yellowish red 53, purple red 51, bright red 47, pale violet 45, orange red 44, clear blue 42, deep yellow 40, bright yellow 34, golden yellow 33, dark blue 33, apple green 26, mineral green 23, very deep blue 19. Hence, we see that the mineral relations of the colors to their heating power is so completely altered, that the violet ray, which in the spectrum possesses temperature 25 or 30 times below that of the red ray, observes here a higher temperature, but the result seems modified as occurs with light by the nature of the power employed, to illustrate the comparative experiments.

Dr. Faraday exhibited many of the experiments which Melloni has described in his papers, especially in reference to the diathermal properties of rock salt, glass, alum, with screens of which substances he had been supplied. The absorptive power of different colors, in relation to the solar spectrum, was well illustrated by means of the oxy-hydrogen blowpipe. The contrivance of passing the decomposed ray through a volume of disengaged ammonia had a happy effect, the colors of the spectrum being as it were made to float in the air.

He likewise exhibited the method of polarizing light by means of tourmaline, by which fanciful figures are formed, and light transmitted or withheld by merely altering the relative position of the screens properly adapted.

REVIEW.

A Treatise on Wood Engraving; Historical and Practical, with upwords of 300 *Illustrations engraved on Wood, by John Jackson.* Knight & Co.

At length this splendid book, of which the public have heard so much, is before them. We have been especially solicitous to procure a copy, that we might examine it and give to our readers an unbiassed opinion of its merits. The work is one printed of a noble size, excellent paper, and the best of type; and in a strong, handsome binding—thus much of its GETTING UP. The contents of it require a longer notice, too long indeed to form but a single paper; we shall therefore confine ourselves at present to the consideration of a single chapter, that on the practical part of the art; and this we are the more anxious to choose and to elucidate, from the recollection that there is no other book published which even pretends to describe the practice of wood engraving, an art which is now, and perhaps ever will be for the future, so much encouraged; an art which all who draw can easily learn—one which is cleanly, elegant, well paid, costs little for tools and materials—may be practiced in a small apartment; is applicable to both sexes, and to youth; and for the products of which there is a constant demand. How much it is to be regretted, that in this country where female employments are so laborious, so little varied, and ill paid, that a genteel art like this, which may be carried on by ladies in privacy and in the bosom of their families and friends, should have been so long unknown: it need be so no longer. Mr. Jackson's book contains every needful instruction, as to the choice of materials, form and application of tools, and progress of the work, from the simplest to the most difficult parts, with examples throughout to render the meaning of his clear instructions still more clear. We have no doubt that many an excellent wood-engraver of the future age will acknowledge how much he is indebted to Mr. Jackson for his first instructions. There are hundreds, however, who cannot afford to purchase the book, yet who are not less anxious to learn; we will therefore do our utmost to assist them, partly with Mr. Jackson's book, and partly with such remarks as our own experience enables us.

As the explanation of the art requires illustrative cuts, we must content ourselves now with directions on the choice and preparation of wood. Mr. Jackson says, page 637,—

"For the purposes of engraving no other kind of wood hitherto tried is equal to box. For fine and small cuts the smallest logs are to be preferred, as the smallest wood is almost invariably the best. American and Turkey box is the largest, but all large wood of this kind is generally of inferior quality, and most liable to split: it is also frequently of a red color, which is a certain characteristic of its softness, and consequent unfitness for delicate engraving. From my own experience English box is superior to all others; for though small, it is generally so clear and firm in the grain, that it never crumbles under the graver; it resists evenly to the edge of the tool, and gives not a particle beyond what is actually cut out; the large red wood on the contrary, besides being soft, is liable to crumble and cut short; that is, small particles will sometimes break away from the sides of the line cut by the graver, and thus cause imperfections in the work.

"Large red wood containing *white spots* or streaks, is utterly unfit for the purposes of the engraver, for in cutting a line across, adjacent to these spots or streaks, sometimes the entire piece thus marked will be removed, and the cut consequently spoiled: a clear yellow color, and as equal as possible over the whole surface, is generally the best criterion of box wood."

Mr. Jackson goes on to state many other reasons why the red, or foreign box wood, is inapplicable to fine work, particularly as on account of its greater softness and porosity, it prints much less perfectly, and is more liable to injury from the press, and the liquids used in cleaning the blocks after printing.

"Box when kept long in a dry place, becomes unfit for the purpose of engraving. When the wood does not cut clear, but crumbles as it were too dry, the defect may sometimes be remedied by putting the block into a deep earthenware jug, or pan, and placing such jug or pan in a cool place for ten or twelve hours; when the wood is too hard and dry to be softened in the above manner, I would recommend that the back of the block should be placed in water in a plate or large dish, to the depth of a sixteenth of an inch for about an hour; if allowed to remain longer there is danger of the block afterwards splitting. Box, when not well seasoned, is extremely liable to warp and bend; if not for immediate use it ought to be placed on one of its edges, and not laid down flat. If a block of this kind be permitted to lay in this manner for a week or two, it is almost certain to turn up at the edges, the upper surface becoming concave and the lower convex. The same thing will occur in the process of engraving, though to a small extent, should the engraver's hand be warm and moist; and also when working by lamp-light without a globe filled with water between the lamp and the block. Such slight warping in the course of engraving is, however, easily remedied by laying the block with its face, that is, the surface on which the drawing is made, downward on the desk or table, at all times when the engraver is not absolutely employed on the subject.

"Many artists who are not accustomed to make drawings on wood, erroneously suppose that the block requires some peculiar preparation. Nothing more is required than to rub the previously planed and smoothed surface with a little powdered Bath brick, slightly mixed with water; as little water as possible is, however, to be used, as otherwise the block will absorb too much, and be afterwards extremely liable to split; when the thin coating is perfectly dry, it is to be removed by rubbing the block with the palm of the hand. No part of the light powder ought to remain, for otherwise, the pencil coming in contact with it will make a coarse and comparatively thick line, which, besides being a blemish in the drawing, is very liable to be rubbed off. The object of using the Bath brick is to render the surface less slippery, and thus capable of affording a better *hold* to the point of the black lead pencil.

"When the principal parts of the drawing are first washed in upon the block in Indian ink it is of great advantage to gently rub the surface of the block, when dry, with a little dry and finely powdered Bath brick, before the drawing is completed with the black-lead pencil. By this means the hard edges of the Indian ink wash will be softened, the different tints delicately blended, and the subsequent touches of the pencil be more distinctly seen. Some artists, previous to beginning to draw on the block, are in the habit of washing over the surface with a mixture of flake white and gum water—this practice is by no means a good one. The drawing indeed may appear very bright and showy when first made on such a white surface, but in the progress of engraving a thin film of the preparation will occasionally rise up before the graver, and carry with it a portion of the unengraved work, which the engraver is left to restore, according to his ability and recollection. This white ground also mixes with the ink in taking a first proof, and fills up the finer parts of the cut. If a white wash be used without gum, the drawing is very liable to be partially effaced in the progress of engraving, and the engraver left to finish his work as he can.

"The less that is done to change the original color of the wood, by white or any other preparation, so much the better for the engraver; a piece of clear box is sufficiently light to allow of the most delicate lines being distinctly drawn upon it."

Mr. Jackson proceeds to show, how a block which may have received an injury, or a part of which may require alteration, is to be mended by PLUGGING, that is, by the insertion of a round piece of wood, driven into a hole properly bored to receive it. This is too tedious for us to enter into, though the operation is extremely simple; we shall proceed next week in showing and explaining the various tools employed: at present, having rather exceeded our usual limits, we must conclude, and will do so by an excellent receipt of Mr. Jackson's at page 723, on transferring a print on to the wood to take a fac-simile from it.

"When a duplicate of a modern, or a fac-simile of an old wood-cut is required, the best mode of obtaining a correct copy is, to transfer the original if not too large or valuable, to a prepared block; and the mode of effecting this is as follows:—The back of the impression to be transversed, is first moistened with a mixture composed of equal parts of concentrated potash and essence of lavender; it is then placed above a block whose surface has been slightly moistened with water, and rubbed with a burnisher. If the mixture be of proper strength, the ink of the old impression will be loosened, and be transferred to the wood. Recent impressions of a wood-cut, before the ink is set, may be transferred to a block without any preparation, merely by what is technically termed, 'rubbing down.' In order to transfer impressions from copper-plates, it is necessary to use the OIL of lavender instead of the essence; if a very old impression apply the preparation to its face."

MISCELLANIES.

Most powerful Electro-Magnet.—The Rev. N. J. Callan, Professor of Natural Philosophy in the Roman Catholic College, Maynooth, has described in Sturgeon's Annals of Electricity, &c., for July, 1837, an electro-magnet, which appears to be by far the most powerful instrument ever constructed. The iron bar of which it is composed weighs fifteen stone, is two and a half inches in diameter, and more than thirteen feet in length, it is bent into the form of a horse-shoe, and the distance between the poles is seven inches. A copper wire one-sixth of an inch in diameter, is coiled once round the whole length of the iron bar. This wire is divided

into seven parts, each about seventy feet long. A thin copper wire about one-fortieth of an inch in diameter, is soldered to one of the thick wires at about a foot from one of its extremities. The thin wire is about ten thousand feet long, it is wound round the magnet in the same direction as the thick wire, and in one continuous coil. By connecting the opposite ends of the seven thick wires with the opposite poles of a powerful galvanic battery, an extraordinary magnetic power is communicated to the iron bar; and, by breaking the battery communication, an electric current of enormous intensity is excited in the long thin wire. The electric power of Professor Callen's magnet, was shown not only by a brilliant combustion of charcoal, but also by the *destruction of animal life.* As often as the connection between charcoal points attached to the thick wires and the battery was broken, the succession of sparks was so rapid, that they formed a continued blaze of vivid light; and when, by means of an electro-magnetic repeater, a rapid succession of the currents excited in the long coil, was passed through the body of a large fowl, instant death was produced.

New Method of Working Caoutchouc.—The employment of either spirits of turpentine, the volatile caoutchouc, balsam of copavia, and the oils obtained from gas-works, as solvents of India-rubber, have the disadvantage of being expensive, and of producing a varnish which dries with much difficulty. For some time past ammonia has been used with advantage. The gum elastic, cut up into shreds, is covered with caustic ammonia, and left in this state several months. The ammonia becomes brown, and the gum assumes a brilliant and silky appearance, resembling a fresh nerve, the caoutchouc swells, but is still elastic, and resembles very closely beautiful silky threads, when drawn out, but it breaks more easily than raw caoutchouc. In treating this swelled caoutchouc with spirits of turpentine, it is easily converted by agitation, into an emulsion, and in a short time it swims on the surface like butter on milk—after this, it acts like varnish. But a much smaller quantity of spirits of turpentine is sufficient to dissolve it than when it has not been softened by ammonia.

Meteoric Paper which fell from the Sky.—On the 31st of January, 1686, a great mass of a paper-like black substance fell with a violent snow storm from the atmosphere, near the village of Randen, in Courland; it was seen to fall, and after dinner was found at places where the laborers at work had seen nothing similar before dinner. This meteoric substance, described completely and figured in 1686, was recently again considered by M. Von Grotthus, after a chemical analysis, to be a meteoric mass; but M. Von Berzelius, who also analyzed it, could not discover the nickel said to be contained in it; and Von Grotthus then revoked his opinion. I examined this substance, some of which is contained in the Berlin Museum, (also in Chladni's collection), microscopically. I found the whole to consist evidently of a compactly matted mass of *Conferva crispata*, traces of a *Nostoc*, and of about twenty-nine well-preserved species of Infusoria, of which three only are not mentioned in my large work on Infusoria, although they have since occurred living near Berlin; moreover, of the case of *Daphnia Pulex*. Of the twenty-nine species of Infusoria, only eight have siliceous shields; the others are soft or with membranous shields. Several of the most beautiful exceedingly rare *Bacillariæ* are frequent in it. These Infusoria have now been preserved 152 years. The mass may have been raised by a storm from a Courland marsh, and merely carried away, but may also have come from a far distant district, as my brother, Carl Ehrenberg, has sent from Mexico forms still existing near Berlin. Seeds, leaves of trees, and other things of the kind, scattered through the mass, were, on the examination of larger portions, easily visible. The numerous native Infusoria, and the shells of the common *Daphnia Pulex*, seem to speak thus much for the substance, that its original locality was not the atmosphere, nor America; but most probably either East Prussia or Courland.—*Professor Ehrenberg.*

Zinc Milk Pails.—Among the patents lately taken out in America, one is for a process for extracting cream from milk by the use of zinc. It is said that if zinc is put into the milk-pail, or the milk be put into a vessel made of that substance, the same quantity of milk will yield a greater portion of cream or butter.—*Repertory of Inventions.*

Asphaltic Mastic.—The asphaltic mastic is obtained from Pyrmont, near Seyseel, and brought down the Rhone. It is a compound of carbonate of lime and mineral pitch. After being roasted on an iron plate, it falls to powder, or may be readily pounded. By roasting, it loses about one fortieth of its weight. It is composed of nearly pure carbonate of lime, with about nine or ten per cent. of bitumen. When in a state of powder, it is mixed with about seven per cent. of bitumen, or mineral pitch, found near the same spot. This bitumen appears to give ductility to the mastic. The addition of only one per cent. of sulphur makes it exceedingly brittle. The powdered asphaltic is added to the bitumen when in a melting state; also, a quantity of clean gravel, to give it a proper consistency for pouring into moulds. When laid down for pavement, small stones are sifted on, and this sifting is not observed to wear off. The mass is partially elastic, and M. Simene has seen a case in which a wall having fallen away, the asphaltic stretched, and did not crack. It may be considered as a species of *mineral leather.* The sun and rain do not appear to have any effect on it; it answers exceedingly well for the floors of the abbatoirs of the barracks in France, and keeps the vermin down; and is uninjured by the kicking of horses. It may be laid down at from eight-pence to nine-pence per square foot.—*Railway Magazine.*

QUERIES.

66.—Is it a fact that gardeners use soot to change the color of flowers? If so, how do they proceed? Soot is employed as a manure, being mixed with seed in sowing. It furnishes to the young roots a large quantity of carbon, in a state easily to be absorbed. Its nauseous bitter principle is also valuable to keep the seedling plants from slugs and insects; but as to changing the color of flowers, it does not appear to have any such tendency.—Ed.

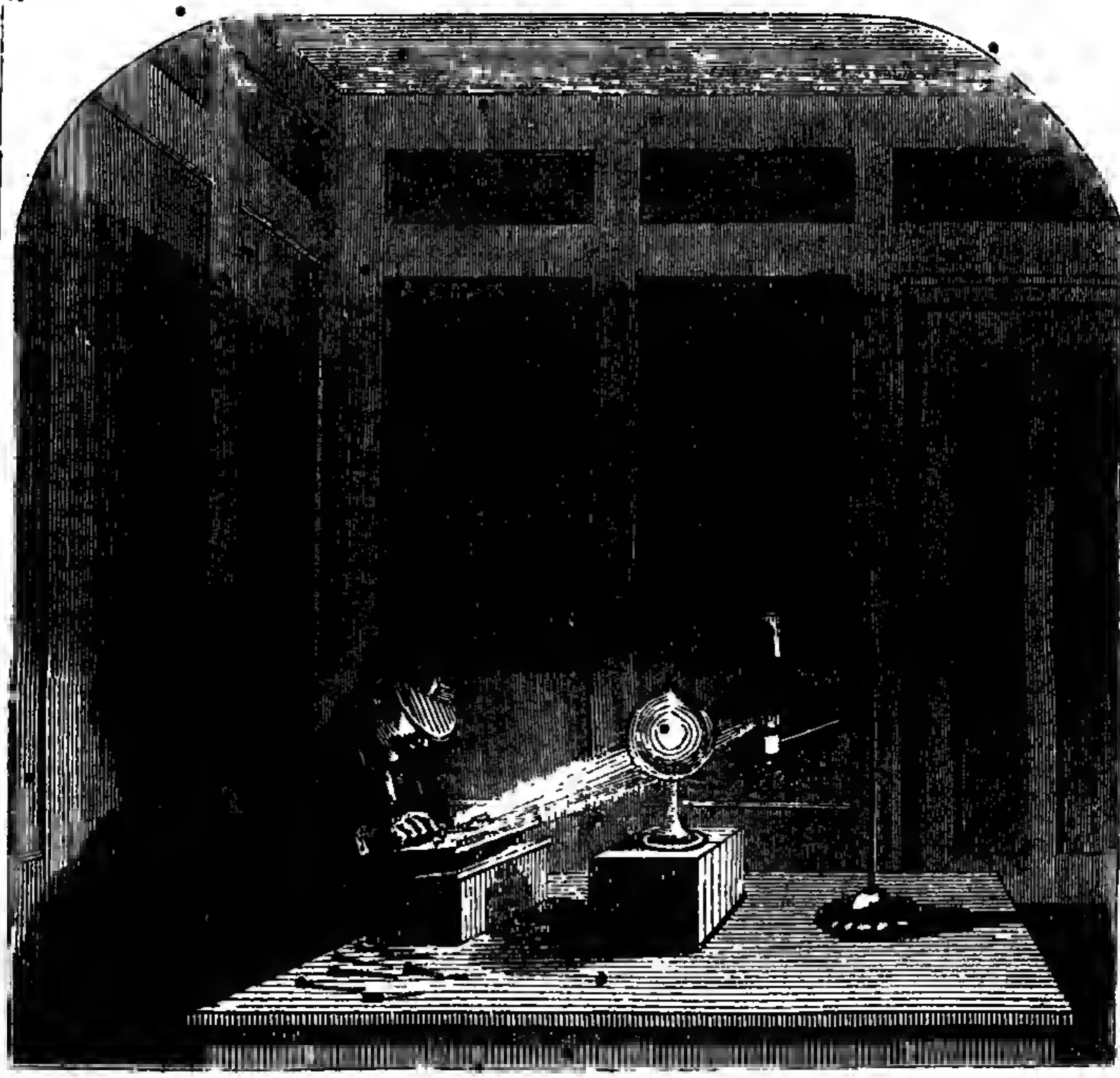
67.—If a thread be twisted tightly round a poker, it will not burn, though held in the flame of a candle. Why is this?—*Answered on page 104.*

68.—What is the construction of the Cosmorama?—*Answered on page 101.*

69.—What is the red varnish for electrical purposes? The best is made by dissolving red sealing wax in strong spirits of wine. Three or four coats of this varnish will give the apparatus a beautiful appearance: it dries quickly, and is very durable.—Ed.

70.—How may tin plates be variegated and colored?—*Answered on page 111.*

POSITION OF THE HANDS WHEN AT WORK.

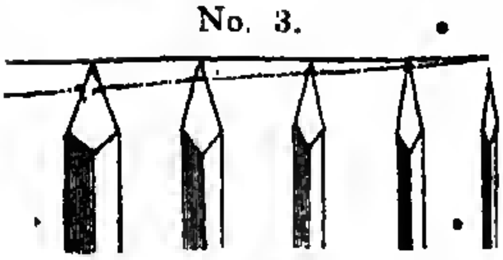


WOOD ENGRAVING.

No. 2—A STRAIGHT GRAVER.

A CURVED GRAVER.

No. 3.



GRAVERS.

No. 4.

CHISELS. GOUGES. TINT TOOLS. GRAVERS.

WOOD ENGRAVING.

(Resumed from page 78.)

THE wood being chosen and prepared, as already described, and the design transferred or drawn upon its surface with a hard fine pointed pencil, it i necessary previous to engraving that it be preserved from injury by being covered with paper, with the exception of that part on which it is intended to begin; upon this Mr. Jackson makes the following remarks:—

"Soft paper ought not to be used for this purpose, as such is most likely to partially efface the drawing where the hand is pressed upon the block. Moderately stout post paper, with a glazed surface is the best; though some engravers, in order to preserve their eyes, which become affected by white paper, cover the block with blue paper, which is usually too soft, and thus expose the drawing to injury. The dingy, grey, and overdone appearance of several modern wood cuts is doubtless owing, in a great measure, to the block when in course of engraving having been covered with soft paper.

"Different engravers have different methods of fastening the paper to the block. Some fix it with gum, or with wafers, at the sides; but this is not a good mode, for as often as it is necessary to take a view of the whole block, in order to judge of the progress of the work, the paper must be torn off, and afterwards be replaced by new wafers or fresh gum, so that before the cut is finished, the sides of the block are covered with bits of paper, in the manner of a wall or shop-front covered with posting bills. The most convenient mode of fastening the paper is to wrap a piece of stiff and stout thread ... or four times around the edges of the block, ... there fastening it. The paper cover will thus ... a kind of moveable cap, which can be taken ... at pleasure, to view the progress of the work, ... replaced without the least trouble."

Mr. Jackson recommends all persons to avoid the use of magnifying glasses, or spectacles, particularly those who are young, and gives the most powerful reasons for his advice, reasons founded not, he says, "upon any theoretic knowledge of objects, but from his own practical experience: that to use glasses to *preserve* the sight, is to meet half way the evil, which is thus sought to be averted." Mr. Jackson says, page 650—"I would recommend all persons to avoid the use of glasses of any kind, whether single magnifiers or spectacles, until impaired sight renders such aid necessary; and even then, to commence with such as are of a low magnifying power: the habit of viewing minute objects alternately with a magnifying glass, and the naked eye, applying the glass every two or three minutes, is, I am satisfied, injurious to the sight. The magnifying glass used by wood engravers is similar to that used by watch-makers; and consists of a single lens, fitted into a short tube, which is rather wider at the end applied to the eye—as the glass seldom can be fixed so firmly to the eye as entirely to dispense with holding it; the engraver is thus frequently obliged to apply his left hand to keep it in its place, as he cannot hold the block with the same hand at the same time, or move it as may be required, so as to enable him to execute his work with freedom: the consequence is, that the engraving of a person who is in the habit of using a magnifying glass has frequently a cramped appearance. There are also other disadvantages attendant on the habitual use of a magnifying glass. A person using such a glass, must necessarily hold his head aside, so that the eye on which the glass is fixed may be directly above the part on which he is at work. In order to attain this position, the eye itself is not unfrequently distorted; and when it is kept so for any length of time it becomes extremely painful. I never find my eyes so free from pain or aching as when looking at the work directly in front, without any twisting of the neck, so as to bring one eye only immediately above the part in course of execution. I, therefore, conclude that the eyes are less likely to be injured when thus employed, than when one is frequently distorted and pained in looking through a glass. I am here speaking merely from experience, and not professedly, from any theoretic knowledge of optics; but as I have hitherto done without the aid of any magnifying power, and am not without reason convinced that glasses of all kinds ought to be dispensed with till impaired vision renders them necessary."

It is therefore to be observed, that these remarks only apply to the young and clear sighted, who would adopt glasses as preservatives to the eye, rather than those who through age, or infirmity of vision, need glasses under other circumstances. Defence, however, to the eye is absolutely necessary, from the glare of light thrown by the lamp on the wooden block; this is best accomplished by a paper or pasteboard shade tied to the forehead, and hanging over the eyes, as represented in the cut: a second shade is occasionally used for the mouth and nose, as in cold and damp weather the drawing upon the block is apt to be obliterated by the breath settling upon it. Upon shading the eyes from light and the face from heat Mr. Jackson observes:—

"There are various modes of protecting the eyes when working by lamp-light, but I am aware of only one which both protects the eyes from the light, and the face from the heat of the lamp. This consists in filling a large transparent glass globe with clear water, and placing it in such a manner between the lamp and the workman, that the light, after passing through the globe, may fall directly on the block. The height of the lamp can be regulated according to the engraver's convenience. By the use of these globes one lamp will suffice for three or four persons, and each person have a much clearer and cooler light than if he had a lamp without a globe solely to himself.

Note.—"The French prefer a bull's-eye lens, of about three and a half inches diameter, flat on one side and convex on the other, to a globe filled with water. This bull's-eye is inclosed in a kind of frame, which can be inclined to any angle, or turned in any direction by means of a ball and socket joint. The light of this is equally good, but the heat affects the head in a disagreeable manner."

Tools.—The next important part of the art is the tools employed and their peculiar application to certain kinds of work; and it is impossible to do this in plainer terms than in the following quotations:—

"There are only four kinds of cutting tools necessary for wood-engraving, namely:—gravers, tint tools, gouges or scrapers, and flat tools or chisels. Of each of these four kinds there are various sizes. The cut, (No. 2,) shows the form of a graver, that is principally used for outlining, or separating one figure from another. This tool is very fine at the point, as the line which it cuts ought to be so thin as not to be distinctly percep-

tible when the cut is printed, as the intention is merely to form a termination, or boundary, to a series of lines running in another direction; though it is necessary that the point should be very fine, yet the blade ought not to be too thin, for then, instead of cutting out a piece of the wood, the tool will merely make a delicate opening, which would be likely to close as soon as the block should be exposed to the action of the press. When the outline tool becomes too thin at the point, the lower part should be rubbed on a hone in order to reduce the extreme fineness.

"About eight or nine gravers of different sizes, beginning from the outline tool, are generally sufficient. The blades differ little in shape, when first made from those used by copper-plate engravers; but in order to render them fit for the purpose of wood-engraving, it is necessary to give the points their peculiar form by rubbing them on a Turkey stone. In the cut, (No. 3,) are shown the faces and parts of the backs of five gravers of different sizes. The lower dotted line shows the extent to which the points of such tools are sometimes ground down by the engraver in order to render them broader. When thus ground down the points are slightly rounded, and do not remain straight as if cut off by the line. These tools are used for nearly all kinds of work, except for series of parallel lines technically called 'tints.' The width of the line, cut according to the thickness of the graver towards the point, is regulated by the pressure of the engraver's hand.

"*Tint tools* are used to cut parallel lines, forming an even and uniform *tint*, such as is usually seen in the representation of a clear sky in wood cuts. They are thinner at the back, but deeper in the side than gravers, and the angle of the face at the point is much more acute—about seven or eight of different degrees of fineness are generally sufficient. The cut will afford an idea of the shape of the blades towards the point. The handle of the tint tool is of the same form as that of a graver. Some engravers never use a tint tool, but cut all their lines with a graver. There is, however, great uncertainty in cutting a series of parallel lines in this manner, as the least inclination of the hand to one side will cause the graver to increase the width of the white line *cut out*, and under-cut the raised one *left*, more than if, in the same circumstances, a tint tool were used. The tint tool being very much thinner than a graver will cause a very trifling difference in the width of a line, in the event of a wrong inclination, when compared with the inequality occasioned by the unsteady direction of a graver, whose angle at the point is much greater than that of a proper tint tool. Tint tools that are rather thick in the back are to be preferred to such as are thin, not only from their allowing of greater steadiness in cutting, but from their leaving the raised lines thicker at the bottom, and consequently more capable of sustaining the action of the press. A tint tool that is of the same thickness both at the back and the lower part cuts out the lines in such a manner that a section of them appears thus

The black or raised lines from which the impression is obtained being no thicker at the base than at the surface, while a section of the lines that is cut by a tool that is thick at the back appears thus.

It is evident that lines of this kind, having a better support at the base, are much less liable than the former to be broken in printing.

"*Gouges*, (see cut, No. 4,) are used for scooping out the wood in those parts that are to be left white towards the centre of the block, while flat tools or chisels, of various sizes, are chiefly employed in cutting away the wood towards the edges. Chisels with projecting corners, which are sometimes offered for sale by tool-makers, ought never to be used, for the projecting corners are very apt to cut *under* a line, and thus remove it entirely, causing great trouble to replace it, by inserting a new piece of wood.

"The face of both gravers and tint tools ought to be kept rather long than short, though if the point be ground *too fine* it will be very liable to break. When the face is long, or strictly speaking, when the angle formed by the plane of the face and the lower line of the blade is comparatively acute, a line is cut with much greater clearness than when the face is comparatively obtuse, and the small shaving cut out turns gently over towards the hand. When, however, the face of the tool is short, the small shaving is rather ploughed out than cleanly cut out, and the force necessary to push the tool forwards frequently causes small pieces to fly out at each side of the hollowed line, more especially if the wood be dry. The shaving, also, instead of turning aside over the face of the tool, turns over before the point, and hinders the engraver from seeing that part of the pencilled line which is directly under it. A short-faced tool of itself prevents the engraver from seeing the point.

"Gravers and tint tools when first received from the maker are generally too hard,—a defect which is soon discovered by the point breaking off short as soon as it enters the wood. To remedy this the blade of the tool ought to be placed with its flat side above a piece of iron—a poker will do very well, nearly red hot. Directly it changes to a straw color, it is to be taken off the iron and either dipped in sweet oil, or allowed to cool gradually. If removed from the iron while still of straw color it will have been softened no more than sufficient, but should it have acquired a purple tinge it will have been softened too much, and instead of breaking at the point, as before, it will bend. A grindstone, Turkey stone, and hone are useful in grinding and sharpening these various tools. The latter is not always used; but a graver that has received a final polish on a hone cuts a clearer line than one which has only been sharpened on a Turkey stone; it also cuts more pleasantly, gliding smoothly through the wood, if it be of good quality, without stirring a particle on either side of the line.

"The gravers and tint tools used for engraving on a plain surface are straight at the point: but for engraving on a block rendered concave in certain parts by *lowering*, it is necessary that the point should have a slight inclination upwards. There is no difficulty in getting a tool to *descend* on one side of a part hollowed out or lowered, but unless the point be slightly inclined upwards, it is extremely difficult to make it *ascend* on the side opposite,

without *getting too much hold*, and thus producing a wider white line than was intended.

"As the proper manner of holding the graver is one of the first things that a young engraver is taught, it is necessary to say a few words upon the subject. Engravers on copper and steel, who have much harder substances than wood to cut, hold the graver with the fore finger, extending it on the blade beyond the thumb, so that by its pressure the point may be pressed into the plate. As box-wood, however, is much softer than copper or steel, and as it is seldom of perfectly equal hardness throughout, it is necessary to hold the graver in a different manner, and employ the thumb at once as a stay or rest for the blade, and as a check upon the force exerted by the palm of the hand, the motion being chiefly directed by the fore finger, as represented in the cut. The thumb, with the ends resting against the edge of the block in the manner represented, allows the blade to move back and forwards with a slight degree of pressure against it, and in case of a slip it is ever ready to check the graver's progress. This mode of resting the thumb against the edge of the block is, however, only applicable when the cuts are so small as to allow of the graver, when thus guided and controlled, to reach every part of the subject. When the cut is too large to admit of this, the thumb then rests upon the surface of the block."—*(See cut.)*

We have now described all the tools employed (except the scraper used in lowering), their particular application, and the method of tempering, sharpening, and holding them. As this has taken a larger space than was anticipated, we must defer giving the learner his first lesson till next week, when we hope to conclude the subject

(Continued on page 97.)

ELECTRICITY.

(Resumed from page 59.)

Before we can process with our experimental researches on electricity, it is necessary to consider some of the fundamental laws by which the fluid appears to be governed; and first as to the difference perceptible when various bodies are subject to electrization. It will have been remarked, that the experiments previously given refer only to particular substances, and were they attempted with other bodies, failure would be the result. Numerous failures of this description attended the labours of the first electricians, and early taught them, that only certain substances were capable of being excited; these obtained the name of Electrics. These it was supposed, at first, were the only bodies which contained the electric fluid, because in them alone could it be made visible. This is a conclusion natural enough in the infancy of a science, but which in its advance was proved to be incorrect, for it is now known that all substances whatever, by taking proper precautions, can be excited, or made to exhibit electrical properties. Notwithstanding this, as totally different means must be adopted in each case, the characteristic term *electric* is still properly continued, and is intended to designate such bodies, as being rubbed, show for some time afterwards the effect of the fluid's disturbance. This is because electrics are of such a nature that the fluid is *not conducted silently away* over their surfaces, but rests there until some other better conducting body draws it off.

Thus we divide all bodies into the two classes of *conductors* and *non-conductors*, or *electrics* and *non-electrics*; the former parting immediately with any fluid given to them, and the latter retaining it so as to be apparent to the senses. Thus air is an electric or non-conductor, were it not so electrical experiments would be unknown, the fluid being dissipated as fast as it is accumulated; water, on the contrary, is a good conductor, hence the necessity of keeping the apparatus dry, that the disturbed fluid may be retained. Metals are the best conductors, therefore we use them for such parts of our electrical machines as are intended for the transit of the accumulated fluid. Glass and silk are electrics, or non-conductors, consequently are available as bodies to be excited, and as capable of preventing its escape and dispersion. Thus of an electric machine the connection between the cushion and the earth is a metallic wire or chain, to allow of the passage upwards of electricity, the glass cylinder being rubbed sets it free, the brass or tin conductor collects it, and its glass support *insulates* it, and thus prevents its escape to the earth again.

It will be evident from the foregoing remarks that a knowledge of the individual conducting powers of all substances is requisite to a right understanding of the first principles of the science, and that even the simplest experiments may be conducted with success. The following table presents a series of conductors and electrics, beginning with those which have the greatest conducting power, and terminating with those that have the least. The order in which they possess the power of insulating is of course the reverse of this; that is to say, the best or most perfect electrics are at the bottom of the table. It may also be observed that the middle of the table exhibits bodies almost neutral in their properties, being but very imperfect conductors, or very slight electrics.

The most perfect or least oxidable metals.
The most oxidable metals.
Charcoal—especially from hard wood.
Plumbago, or blacklead.
The mineral acids.
Metallic salts and ores.
Water, and other liquids; and snow.
Living vegetables and animals.
Smoke, soot, and steam.
Rarified air and flame.
Dry earths and stones.
Pulverized glass.
Flowers of sulphur.

Dry metallic oxydes.
Oils.
Vegetable and animal ashes.
Ice; when cooled down to 13° Fah.
Phosphorus.
Lime, dry chalk, and marble.
Caoutchouc, camphor, and bitumen.
Silicious and argillaceous stones.
Porcelain.
Baked wood.
Dry atmospheric air and other gases.
White sugar and sugar candy.
Dry parchment and paper.
Cotton.
Feathers, hair, and silk.
Transparent gems.
Glass.
Fat.
Wax.

Sulphur.
Resins.
Amber and gum-lac.

It will be seen from the above, that a particular substance may be an electric in one state and a conductor in another; thus glass and sulphur are both excellent electrics when in masses, but when pulverized become imperfect conductors. So green wood is a conductor; baked wood a non-conductor; baked still more into charcoal a conductor again; and when in the state of wood ashes a non-conductor once more. Many bodies also are conductors merely because they contain water; thus almost all highly-dried animal, vegetable, and mineral matters are non-conducting, as dried glue, parchment, bone, ivory, hair, feathers, horn, tortoise-shell, wool, silk, gums, resins, wax, cotton, sugar, &c. &c., are electrics, yet as soon as either of them becomes damp, a conducting property is communicated, hence the necessity of well drying electrical apparatus when in use; and also the same fact shows the reason that machines of this kind act so imperfectly in damp weather, or in a room before a crowded audience, whose breath quickly settles in moisture upon the various electrics around. Too great heat also impairs the insulating effect of glass, &c., for although it will not in ordinary temperatures suffer the fluid to pass along its surface, yet when heated to redness it becomes a good conductor; and so also is baked wood made very hot, melted resin, hot air, &c..

To discover if a body be an electric or not, hold it against the conductor of a machine when charged, if a spark can now be taken by the knuckle from another part of the conductor, the substance under examination is an electric, if not it is a conductor. If a liquid, a gas, or a powder, is to be tried, inclose it in a glass tube; should the spark not now pass, it will be known to have been conveyed away by the liquid, &c. under trial.

(Continued on page 106.)

MATERIALS FOR PAPER.

(Resumed from page 45.)

In the Transactions of the Society for the Encouragement of Arts, &c., numerous experiments are detailed of the manufacture of paper from various materials, and in their library is to be seen a book written in German, containing between thirty and forty specimens of paper made of different materials. The author of this curious work was apparently one of those enthusiasts, who became so enamoured of a particular pursuit, as to cause every thing to be subservient to the one great end which they propose. However the more phlegmatic may sometimes be tempted to smile at the curious conceits and strange speculations of these characters, it is to such that the world is indebted for many of the most useful discoveries and improvements which mark the progress of the arts and sciences. The same enthusiasm of character, the same tenacity of purpose, have alike been exerted in perfecting the magnificent conceptions of genius, as in increasing the material for that paper on which these are recorded. Let us not slight the indefatigable labourers who have pursued the less splendid, though no less useful objects of inquiry.

A minute detail of the numerous experiments made by M. Schaffer does not come within the scope of this work. A slight notice, however, may not, perhaps, be wholly without interest, as it will serve to show what a boundless store is contained within the vegetable kingdom, convertible into this increasingly useful purpose.

M. Schaffer relates that his interest in the pursuit becoming well known, every body was anxious to supply some material, or to suggest some hint in futherance of his views, and that the most heterogeneous substances were constantly presented to him, with the question "Can you make this into paper?" His account of the causes which led him to many trials of different substances is confirmatory of the foregoing, while it illustrates the observation, that from the most trifling circumstances useful knowledge may be obtained by those who walk abroad with their senses and understandings alive to surrounding objects.

By this means, and by the zealous co-operation of those more immediately about him, M. Schaffer affirms that his catalogue was much increased; while he became so absorbed in the all-engrossing subject, that it would seem the whole world assumed to him the character of one vast mass of latent material for paper.

The bark of various trees, of the willow, the beech, the aspin, and the hawthorn, have been successfully formed into paper. That made from the bark of the lime-tree is of a reddish-brown color, and so extremely smooth as to be peculiarly well calculated for drawings; the paper produce of this bark is not merely confined to the leaves of a book of specimens, but it is manufactured for useful purposes in some of the northern parts of the Continent. The wood, as well as the inner bark of the mulberry, is likewise capable of being made into this substance. A specimen of paper made from the down of the catkins of the black poplar is of a very superior quality, being very soft and silky. A paper similar to the last was likewise produced from the silky down of the *asclepias*, with the admixture of a portion of linen rags.

The tendrils of the vine, after being subjected to putrefactive fermentation, can be converted into tolerable paper.

The stalks of the mugwort, or *artemisia*, formed another material of nearly similar quality. This plant may almost be considered a weed, as it grows spontaneously on banks and on the sides of foot-paths, and its roots spread and propagate very rapidly. The nettle is another weed from which two kinds of paper have been made; the one from the rind, the other from the ligneous part. The paper manufactured from this plant by M. de Villette was of a dark green color; that produced by M. Schaffer is tolerably white.

The stalks of the common thistle, as well as the down which envelopes its seed, were both made available to this purpose. In relating the manner of manufacturing these stalks into paper, it is stated that the first experiment perfectly answered; a pulpy substance was produced which cohered in thin sheets, but on a second trial, vain were the maceration and subsequent manipulations, it refused to become a coherent mass, and paper could not be produced without the addition of linen rags. The same mysterious failure happened with regard to the burdock, another weed bearing a prickly head and a fibrous stalk. The disappointed experimenter endeavoured to discover the reason of so unexpected and vexa-

tious a result, which he with much solemnity avers would by some superstitious persons be attributed to the intervention of witchcraft, exercised by some evil-minded persons; but he gravely disclaims for himself any belief in such influence. It is matter of surprise that at so late a period any cause should exist to warrant this self-congratulation on being exempt from so gross a popular prejudice. At a subsequent period, M. Schaffer was led to suspect that this want of success might possibly have arisen in consequence of the more mature age of the plants, which rendered them woody, and less capable of being formed into a pulp.

The bark and stalk of bryony—the leaves of the *typha latifolia*, or cat's tail—the slender stalks of the climbing *clematis*—the more ligneous twigs of the branching broom—the fibrous stem of the upright lily—and the succulent stalks of the lordly river-weed, all were alike successfully brought into a pulpy consistence capable of cohering in thin and smooth surfaces.

Substances yet more unpromising did this persevering experimentalist endeavour to convert to his favorite object. Turf-tree, earth, and coral moss were successfully manufactured into paper. Even cabbage-stalks, wood-shavings, and sawdust, were each in turn placed under process, and specimens of the result are to be seen in the above-mentioned book. Then the rind of potatoes was acted upon, and finally the potatoe itself; this latter substance proved a most excellent material, producing a paper extremely smooth and soft to the touch, while its tenacity approached nearer to parchment than any other vegetable substance thus employed, and caused M. Schaffer to esteem it as a valuable drawing-paper, which he recommended should be manufactured exclusively for that purpose, as he supposed that an edible substance might be deemed too valuable to allow of its extensive use, except as an article of food.

A good and cheap paper was produced from "pine buds," which, from the description given of them, are the common fir-apples, or fruit of fir-trees. These are well known as being hard, woody cones, composed of scales overlapping each other. A singular accident led to the attempt with so apparently unappropriate a substance.

M. Schaffer's foreman had purchased a particular kind of bird whose natural food is the fir-apple. Soon after it had been provided with its first meal the man remarked a considerable quantity of downy litter in the bird's cage, and supposing that it had been negligently introduced with its food, the careful owner cleansed the cage, and procured a fresh supply of the pine buds. After a time, the same appearance was again observed in the cage, and on watching the movements of the bird, it was found diligently tearing to pieces each scale of the cone, until at length the whole assumed the form of a ball of tow, and then it was in a proper state of preparation to be used as food by the feathered epicure. Profiting by this hint, its owner went joyfully to tell the wonderful labours of the industrious bird, and how it had converted the harsh fir cone into a material of which paper could be made. No time was lost in imitating the operations of the bird on the fir-apple, and paper was shortly produced extremely strong and serviceable, and fit for use as a wrapping paper.

(Continued on page 94.)

DEW, HOAR-FROST, FOG, CLOUDS, AND RAIN.

When a space which contains a certain amount of vapour is cooled, it always approaches more and more a state of saturation, and at a sufficiently low temperature a portion of the vapour is converted into water, and precipitated. It is thus that there is produced a moist coating on a glass of cold water when it is brought into a warm moist room: thence may be explained the moisture on windows during winter, inasmuch as the vapour is precipitated on the cold glass; and from the same cause a mist is formed over a vessel of warm water. What we thus perceive on a small scale, nature is constantly performing on a great. When, for example, the sky is clear and no wind blows, the ground is cooled rapidly during the night by the radiation of the heat, and the stratum of air next the ground is some degrees colder than the air a few feet above. At last the ground is so much reduced in temperature, that the strata of air lying next it are saturated with vapour, and, by a continuance of the cooling, vapour is precipitated on glass and other objects, in the form of drops, or in winter in a crystalline condition. The dew, or hoar-frost, is so much the more considerable the greater the cooling, and hence the older natural philosophers ascribed to dew a cooling power, until at length Wells proved that the cold is not the effect but the cause of the dew, just as in winter the windows must be cold before they begin to show their covering of moisture. Exactly the same phenomenon, which we perceive when warm water evaporates in cold air, is presented to us by nature in the colder periods of the year, when, for example, in autumn, the heat of the air diminishes very rapidly. From rivers and from smooth sheets of water, which still possess a high temperature caused by the summer, a quantity of vapours arise; the air which is more especially cold in the morning is saturated in a short time, and the vapours ascending further, become condensed, and float as water in the form of hollow vesicles in the air, giving rise to a fog, from whose position we can often at a distance trace all the windings of a river. If this fog becomes denser, several such vesicles unite together in drops and fall to the ground as fog-rain.

In general, we must suppose, that all clouds arise from the circumstance of the air in which they float containing more vapour than is enough for saturation; so that we must regard the clouds as fogs which are continued upwards, and from which rain, or in colder weather, snow descends, when the super-saturation of the atmosphere becomes still greater. However varied the circumstances may be relating to the formation of clouds, yet one law lies at the foundation of the whole of them, which was first announced by Hutton, viz., wherever two nearly saturated masses of air of unequal temperament become mixed, either a precipitation takes place, or, at all events, the mixed mass of air is relatively moister than either of the separate masses.

Rain being formed by the mixing of two masses of air of different temperatures, the colder part, by abstracting from the other the heat which holds it in solution, occasions the particles to approach each other and form drops of water, which, becoming too heavy to be sustained by the atmosphere, sink to the earth by gravitation in the form of rain. The contact of two strata of air of different temperatures, moving rapidly in opposite directions,

…ns an abundant precipitation of rain. When the masses of air differ very much in temperature, and meet suddenly, hail is formed. This happens frequently on hot plains near a ridge of mountains, as in the South of France; but no explanation has hitherto been given of the cause of the severe hail storms which occasionally take place on extensive plains within the tropics.

Between the tropics, where all meteorological phenomena occur with great regularity, the phenomena connected with rain are much simpler than in our regions, if local circumstances do not occasion a disturbance. Where the ascending current of air acts with power in the region between the two trade winds, a great quantity of vapour reaches the upper colder regions of the atmosphere, which is then rapidly condensed and descends as rain. This process takes place more especially when the sun, about the time of its culmination, acts powerfully on the ground. Hence generally the morning and evening are serene, and the rain falls in the afternoon. As the sun in its yearly course moves further to the south than to the north, the region moves with it in which the ascending current of air, and consequently the rain, is greatest; when the sun removes from a region, the rain becomes less considerable, and at last fine weather returns. This alteration occurs so regularly, that between the tropics, the year has been divided into two halves, the dry and the wet season.

In our part of the world, where, in the course of the year, the NE. and the SW. struggle for predominance, the phenomena are more complicated, but still may all be referred to a few simple laws, if we keep before our eyes the circumstance that the SW. is a wind which, in consequence of its origin, blows above and then sinks to the ground, while the NE. spreads itself from below upwards. If with this, we further combine the circumstance that the SW. wind, as it comes from warmer regions, brings along with it moist air from the Atlantic ocean, whereas the cold NE. brings dry air from the interior of the continent, we can easily understand that these two winds must exercise a very unequal influence on the abundance of the precipitations. Observations made for several consecutive years at any place on the plains of Germany, always show that the SW. and W. are the winds during which it rains most abundantly, while the easterly winds are much more rarely associated with falls of rain. The changes of the pressure of the air stand in such intimate connection with the transitions from a serene sky to a troubled one, and to rain, that the barometer has been justly named the weather glass, and it seems advisable to consider both phenomena at the same time.

GRADUATION OF GAS JARS, TEST TUBES, &c.

GRADUATION, generally speaking, consists in dividing lines, surfaces, and capacities, into a certain number of equal or proportional parts. For standard thermometers and other instruments which require to be made very accurate, it is necessary to employ tubes which are extremely regular in the bore. When a drop of mercury, passed successively along all parts of the tube, forms everywhere a column of the same length, the examiner is assured of the goodness of the tube.

That a tube may be regular in the bore, it is not necessary that the bore be cylindrical; it is sufficiently accurate when equal lengths correspond to equal capacities. A tube with a flat canal, for example, can be perfectly accurate without at all approaching the cylindrical form. It is only necessary that a drop of mercury occupy everywhere the same length. We may observe, by the way, that, in flat canals, the flattening should be always in the same plane.

As it is very difficult to meet with capillary tubes which are exactly regular in the bore, it happens that the tubes which glass-blowers are obliged to employ have different capacities in parts of equal length. You commence the division of these tubes into parts of equal capacity by a process described by M. Gay-Lussac. You introduce a quantity of mercury, sufficient to fill rather more than half the tube, and make a mark at the extremity of the column. You then pass the mercury to the other end of the tube, and again mark the extremity of the column. If you so manage that the distance between the two marks is very small, you may consider the inclosed space as concentric, and a mark made in the middle of the division will divide the tube into two parts of evidently equal capacity. You divide one of these parts, by the same process, into two equal capacities, and each of these into two others; and in this manner you continue to graduate the tube until you have pushed the division as far as you judge proper.

But it is still more simple to introduce a drop of mercury into the tube, so as to form a little cylinder, and then to mark the two extremities of the cylinder. If it were possible to push the drop of mercury from one end of the tube to the other, in such a manner as to make it coincide, at every removal, with the last mark, it would be very easy to divide the tube accurately; but as it is very difficult, not to say impossible, to attain this precision of result in moving the column of mercury, you must endeavour to approach exactness as nigh as may be. You measure, every time you move the mercury, the length of the cylinder it produces, and carry this length to the last mark, presuming the small space which is found between the mark and the commencement of the column to be fairly represented by the same space after the column. You thus obtain a series of small and corresponding capacities.

If the tube is regular in the bore, close one end, either by sealing it at the lamp, or by inserting a cork, and pour into the interior two or three small and equal portions of mercury, in order to have an opportunity of observing the irregularities produced by the sealed part. Take care to mark, with a writing diamond, the height of the mercury, after the addition of each portion. When equal portions of mercury are perceived to fill equal spaces, take with the compass the length of the last portion, and mark it successively along the side of the tube, where you must previously trace a line parallel to its axis.

For tubes which are irregular in the bore, and where equal lengths indicate unequal capacities, it is necessary to continue the graduation in the same manner that you commenced it—that is to say, to fill the tubes by adding successively many small and equal portions of mercury, and marking the height of the metallic column after every addition. These divisions will of course represent parts of an ounce or of a cubic inch, according to the measure which you make use of. When you have thus traced on

the tube a certain number of equal parts, you can, by means of the compasses, divide each of them into two other parts of equal length. The first divisions being very close to one another, the small portion of tube between every two may be considered, without much risk of error, as being sensibly of equal diameter in its whole extent.

When the tube which you desire to graduate is long and has thin sides, it would be difficult to fill it with mercury, without running the risk of seeing it break under the weight of the metal. In this case you must use water instead of mercury.

Bell-glasses of large dimensions are graduated by filling them with water, placing them in an inverted position on a smooth and horizontal surface, which is slightly covered with water, and passing under them a series of equal measures of air. But it is then necessary to operate constantly at the same temperature, and under the same atmospheric pressure, because air is very elastic, and capable of being greatly expanded.

In all cases, tubes, bell-glasses, &c., ought to be held in a position perfectly vertical. The most convenient measure is a dropping-tube, on the stalk of which a mark has been made, or a small piece of tube, sealed at one end, and ground flat at the other; the latter can be accurately closed by a plate of glass.

The marks which are traced on tubes being generally very close to one another, you facilitate the reading of the scale by giving a greater length to those marks which represent every fifth division, and by writing the figures merely to every tenth division. The number of divisions is somewhat arbitrary; nevertheless, 100, 120, 360, 1000, are divisions which, in practice, offer most advantages.

MISCELLANIES.

Artificial Pearls.—It has been suggested that the pearly lustre of the crystals of certain salts, especially the double cyanides, is so beautiful, that their employment might supersede the cruel practice of stripping the scales from living fish for the manufacture of artificial pearls. Oxalic acid may be formed by the action of nitric acid upon alcohol, under certain conditions, in pearly scales.—*Proceedings of the British Association.*

Vegetation in a Solution of Arsenic.—M. Gilgenkrantz has seen a plant of the genus *Leptomitus*, or *Hygrocrocis*, form in a solution of arsenic. This observation, communicated by M. Bory St. Vincent, proves that arsenic, a substance so very poisonous, and supposed to be destructive to all organized bodies, is, however, favorable to the vegetation of some plants. M. Bory St. Vincent mentioned on this occasion, that M. Dutrochet had observed about ten years ago the development of a similar plant in a solution of acetate of lead.

Oxalic Acid found in great quantities in Lichens, &c.—N. H. Braconnot has discovered that oxalate of lime forms nearly one-half of the weight of a great number of lichens, to which it bears the same relation that carbonate of lime does to corallines, and phosphate of lime does to bones. The oxalate diminishes progressively in the family of lichens, as the species lose their crustaceous granular texture, and acquire a foliated membranaceous aspect, but the latter still contain a remarkable quantity. About 17 parts of yellowish white oxalic acid were obtained from 100 parts of the pulverized lichen *Ann. de Chim.* xxxlii. p. 318.

Action of Nitric Acid on Charcoal.—Professor Siliman having announced the formation of hydrocyanic acid, by the action of nitric acid in charcoal, M. Frislani was led to the same result in the following manner:—In treating with nitric acid the residue of the calcination of sulphate of barytes with charcoal, he smelt bitter almonds. This made him suppose that the prussic acid was formed. He repeated the experiment in a glass bottle, and heating the liquor with sulphate of iron, he obtained Prussian blue. The boiled nitrates and that of barytes, decomposed by charcoal, do not produce the same effect.—*Giorn. de Fis. &c.* 1824. p. 240.

To Duthcify Quills.—Immerse the quills when plucked from the wing in water almost boiling; leave it there till it becomes sufficiently soft; compress it, turning it on its axis with the back or blade of a knife. The immersion and compression must be continued till the quill is clear when cold, and the membrane and greasy covering is entirely removed: it is immersed a last time to render it cylindrical, which is done by whirling it between the thumb and index finger; it is then dried in a gentle temperature. The French discovered this process when they conquered Holland.

Model of the first English Steam Vessel.—The following notice appeared in the *Oracle* daily newspaper, December, 1789:—"There has lately been laid before the Admiralty Board the model of a ship, worked by steam, which is so constructed as to sail against wind and tide. This ingenuity is to be rewarded by a patent."

Everlasting Lamps.—These lamps, (of which many consider the accounts altogether apocryphal,) are supposed to have been formed with inconsumable asbestos wicks; but the composition employed to feed them it is utterly impossible to surmise, because naphtha, which it is said to have been, as well as every other oleaginous substance, would consume, if the lamp-wicks did not, and be converted by sublimation into soot. The secret then, of making everlasting lamps is utterly lost to us, if, indeed, it were known to the ancients; and they were so jealous of affording any light on the subject to future ages, that these illuminators, used only in sepulchres, were so contrived, that bricked up therein, they might and could burn for ever; but either went out immediately upon the admission of the external air, or were, by mechanical contrivances, instantly extinguished; thus disappointing the curiosity or cupidity of invaders of the tomb. Rosicrucius, the mystic, alchemist, and philosopher, is said to have discovered the secret of the composition of these ancient lamps; and the story concerning his sepulchre will be found in one of the numbers of the *Spectator*.

QUERIES.

71—Why is the breath visible in frosty, and not in warm weather? Because it is kept in solution in warm weather, but the vapour is instantly condensed in frosty weather.

72—What is the reason that a razor cuts better after being dipped in hot water?

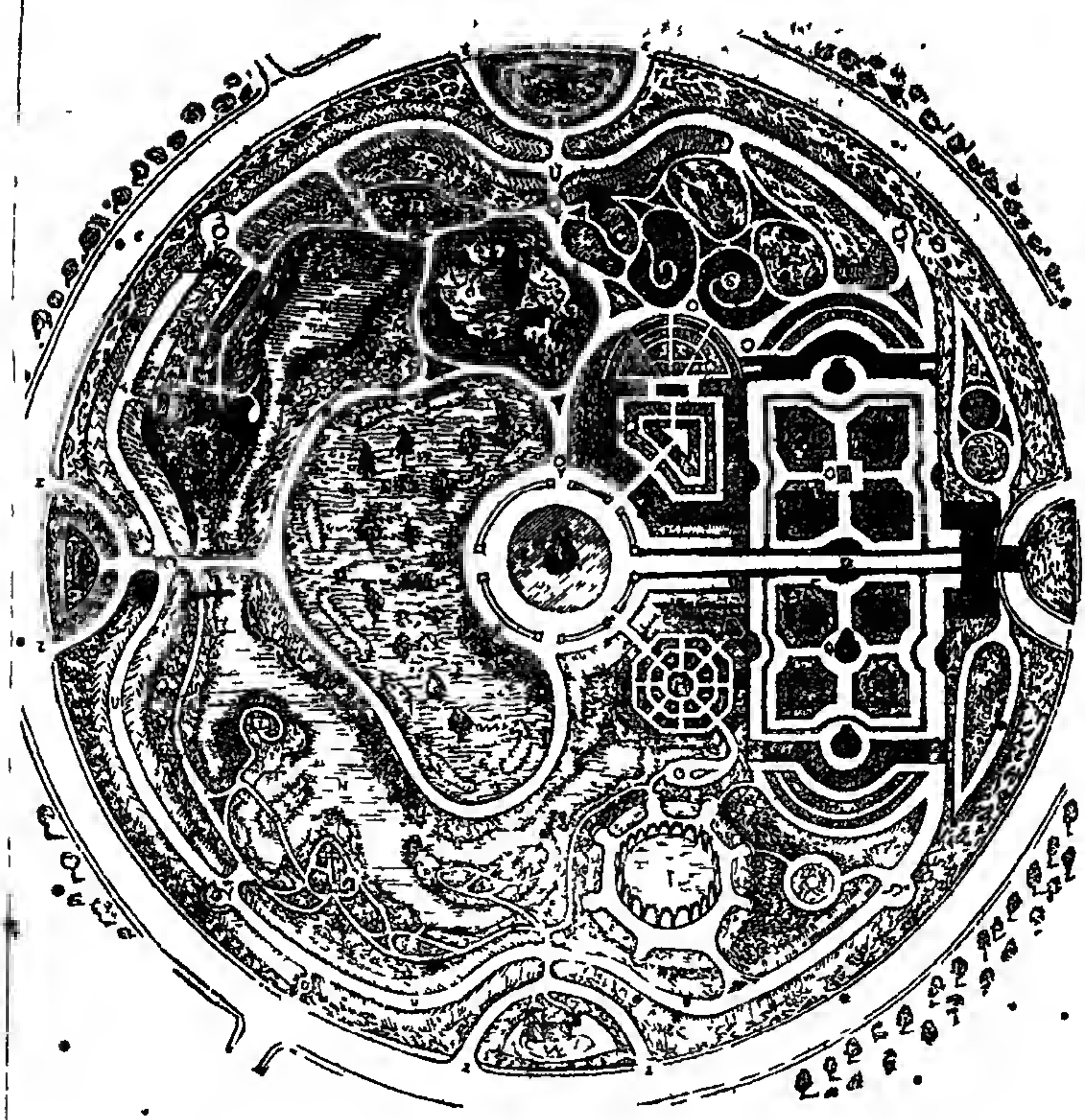
73—Why does fire burn better in winter than summer? Or why does the sun's beams extinguish a fire?

74—How are we to account for the non-freezing of Loch-Ness?

75—Why does the freezing of flesh, &c., preserve it from putrefaction?

76—When a sudden thaw comes, why are the outside walls of our houses covered with hoar frost?

77—How is the varnish made for patent leather?



PLAN OF THE ROYAL BOTANIC GARDEN, REGENT'S PARK.

A—Principal Building, containing the Botanical Museum and Library, Reading, Drawing, and Lecture Rooms
B—Gardens attached to the Establishment.
C—Italian Garden, with Raised Terraces, Fountains, &c.
D—Grand Promenade
E—Extensive Domed Conservatory.
F—English Garden
G—Medico Botanic Garden, with Hot houses, &c
H—Dutch Garden, with Canals and Fountains
J—Rosarium, with Arched Trellis Work for Roses.
K—Swiss Cottage and Garden upon an Island
L—Oriental Garden, with Kiosks, Pagodas, Bridges, &c
M—American Garden
N—Lake and small Islands for Willows, &c
O—Artificial Rock-Work, with Reservoir and Cascade.
P—Hermitage and Labyrinth
Q—Arboretum and Shrubbery
R—Lawn, with Drooping Ash Trees
S—Mound, with Prospect Tower
T—Lawn for Busts of Celebrated Botanists and Scientific Men
U—Grand Walk.
V—Belt of Trees and Shrubs surrounding the Gardens.
W—Ornamental Residences for Officers of the Establishment
X—Statues, Vases, Sun Dials, and other Works of Art.
Z—Exit Town Gate

ROYAL BOTANIC GARDEN.

NOTWITHSTANDING the manifest importance of a proper acquaintance with the productions of the vegetable kingdom, there is not, to this day, in the metropolis of the commercial world, a public establishment devoted to their general study; and while foreign countries possess such institutions, (and there are forty in our own empire,) we are the last to avail ourselves of their advantages. The benefits to be derived from a properly-directed botanic garden are so apparent, that it argues an inconceivable deficiency in our local administration that they should be so long neglected. The only way in which the study of botany has received attention has been for medical purposes; and it is to be regretted that that knowledge should be considered as restricted to one profession, which is capable of still further developement. The chemical properties of plants are not confined to their medical uses, but exercise important functions in manufactures. The employment of vegetable productions in textile fabrics makes them an object of commercial importance, and renders them deserving of scientific investigation; and the manufacturing properties of plants are so various as at once to open a wide field for observation, and inculcate the necessity of it. The adaptation of botanical subjects is the principal source of patterns for textile and imitative goods, and a facility for studying such objects a great desideratum for the improvement of our manufactures.

Mr George Rennie, the sculptor, attributes the excellence of the French artists to their superior facilities for studying design, and particularly recommends instruction in botanical drawing.

Mr. Donaldson, the architect, says—"That the manufacturing artists require instruction in botany, as connected with construction, in order to give the workman an insight into the nature and properties of vegetable substances, and a more accurate knowledge of their forms when he wishes to delineate or model them; all which may be very much derived from the study of their growth and formation."

While the importance of botanical study is such in the lower walks of art, it is not of less necessity in its higher and more unequivocal branches. The delineation of the flower has in all countries afforded many fine paintings, a branch in which ladies have been particularly successful, and in which it was the pride of Rubens to excel equally as in the other departments of art. In all that relates to decoration, however, its application is of primary importance. Foliage is the basis of the arabesques of Pompeii, and those of Giulio Romano; and, while an increasing inclination is exhibited for these styles among the patrons of art, the only [illegible] source of their power should not be neglected. [illegible] of architecture have, even in th[illegible] nations, derived their origin from [illegible] and the palm leaf of the Temple, [illegible] of Egypt, were not less favorites with [illegible] respective admirers than the variegated foliaged ornaments of the Greeks. These latter, in the acanthus and the honeysuckle, found a harmony and beauty which they made productive of the greatest effect, while the Gothic architects, in the profusion of their architectural enrichments, displayed even a greater variety and research.

In our colonies the foundation of botanical gardens has been an object of government solicitude: nor has private enterprise been neglectful in promoting them in our own country. The two universities, Oxford and Cambridge, have botanical gardens; so also have Birmingham, Liverpool, Sheffield, Manchester, Leeds, Hull, Bury St. Edmunds, and Colchester; and they have been recently established at Cheltenham and Newcastle-upon-Tyne. In Scotland there are gardens at Edinburgh and Glasgow. In Ireland, at Dublin, is one belonging to Trinity College, and the splendid establishment at Glasnevin, of the Dublin Society; there are others at Cork and Belfast.

In examining what has been [illegible] the neighbourhood of the metropolis, we shall find that there is sufficient encouragement to induce us to supply the deficiency. At Chelsea is a small garden of three acres, founded in the seventeenth century, and given in 1721, by Sir Hans Sloane, to the Apothecaries' Company, and devoted by them to the study of medicine, and of which they now contemplate the abandonment, if they can obtain a more suitable locality. Those at Kew have obtained considerable reputation, but are at too great a distance to be available to the great mass of the metropolitan population, while their system of management is far from being adequate to the requisites of a national institution.

With such acknowledged advantages to be derived from the establishment of a botanic garden, and with such a tendency of public taste, it would appear surprising that such an object should have hitherto been neglected. This deficiency is now, however, to be supplied, and in such a manner as, it is to be hoped, will satisfy every votary of science. Although previous abortive attempts had been made to effect this object, the merit of it rests with several members of the Linnæan Society, whose success confers equal honor on the Society by which it was promoted and on their enlightened exertions.

The Society will be constituted similarly to other scientific societies, and will be under the management of a president and council, and composed of fellows and members. It will, doubtless, be incorporated by Royal Charter, and its importance can hardly fail to obtain for it great influence; while the manner in which it is regarded by the Linnæan, Horticultural, and Botanical Societies, does honor to their liberality, and to the cause of science.

The site chosen is the inner circle of the Regent's Park, once occupied as Jenkins' nursery ground; its extent exceeds eighteen acres. That its position is eligible is best [illegible] by referring to the neigh[illegible] of the Zoological Society, while its [illegible] petent for the purposes intended. [illegible] gardens contain only three [illegible] twenty, and where they do they are employed either in the cultivation of medicinal plants for the hospitals, or in the growth of fruit for the market. Its appropriation will be no encroachment on public enjoyments, while, if properly directed, it cannot fail to confer great advantage on the whole empire. The artistical details of the plan, as shown in the accompanying cut, are formed upon an observance of the most enlightened principles, and it has been the endeavour in this department and in others, to make science and art equally conducive to the improvement of popular taste.

The geographical and physical distribution of plants is to be preserved as much as possible, and a

necessary adjunct is the application of national architecture in the buildings devoted to the production of individual countries. [illegible] artistical decorations, as statues and [illegible] be employed as far as possible [illegible] to praise of the objects of [illegible] in this department, without going into any unnecessary expense, they may powerfully contribute to the cultivation of public [illegible]. While [illegible] ornamental edifices [illegible] of the various styles of [illegible] statues and [illegible] a gallery [illegible] an opportunity of [illegible] with the best production of the several schools, and the elucidation of this object should be by no means omitted in the catalogue of the gardens. The selections might include casts of the several styles of Egyptian art, and of the finest ancient and modern specimens of the several Greek, Italian, French, and English schools. The plants are to be arranged according to the two great systems of classification—the artificial and the natural; and will likewise be disposed in such a manner as may be useful to every class of botanists. The artificial system, or that of Linnæus, founded on the visible organs of plants, which presents great facilities of reference.

The circle is proposed to be distributed into compartments, for the reception of the several plants, indigenous to Europe, Asia, Africa, America, Australia, and the Polar Regions. These again are proposed to be subdivided into gardens, in illustration of the style of ornamental gardens of the several counties of the great divisions.

At the entrance of the grounds from the grand drive leading from the Colosseum a building will be erected, devoted to the general business of the Society, and containing a library, museum, and rooms for study. The library will consist of botanical works and periodicals, and to it will be annexed a reading-room for the use of Fellows and Members. The museum will contain dried specimens, drawings, and engravings of recent plants, and specimens of fossils; and it would augment the value of these latter if they were accompanied by such recent plants as are identical to them, or have the nearest relation.

The conservatory will be on a very large scale, so as to give every facility for the growth of the more magnificent tropical plants. Descending from the conservatory, to the right of the grand promenade, we come to a garden laid out in the Dutch style, [illegible] in the centre, and canals. Beyond [illegible], consisting of a circular lawn [illegible] trellis-work and borders, for the growth of every variety of this queen of flowers. [illegible] garden, laid out [illegible] terraces, at one end of which will be a [illegible] and at the other [illegible] passed [illegible] the promenade [illegible] medico-botanical garden, a[illegible] the central conservatory, and surrounded by hot-houses, stoves, &c. We are now at the head of the lake, which will extend for about a quarter of a mile, interspersed with islands, and winding amid varied scenery. Here will be cultivated aquatic plants, and there will also be provided a salt-water basin for marine algæ. At the head of the lake will be an artificial rock for the cultivation of rock-plants, and which will contain a large reservoir to supply the several fountains and hydraulic works. Around the shores of this lake will be arranged every variety of architecture, and on its borders will be seen the pointed arch of the Spanish Moor, and its kindred styles, the Turkish and Persian kiosk, while by the side of these latter may be exhibited models of those interesting monuments, the Persepolitan remains. Further on the style of the Hindoo will again claim affinity with the pointed works of the Moor and the Goth, and the better known style of the Chinese will appear with its many-roofed pagoda. Between the lake and the central conservatory will be an extensive lawn, upon which ornamental shrubs and parterres of flowers will be displayed in the modern English style. In its special department will be a garden, devoted, like that at Glasgow, to the cultivation of plants used in manufactures; and the dyer may here see the material of his tints, or the weaver the cotton from which his cloth is spun. In proper situations will be the American or bog-earth grounds, and around the whole ground is to be a walk with wide borders for the arrangement of plants in scientific order.

In conclusion, it may be necessary to observe, that the plan is now in active operation, although a considerable time must elapse before so extensive a design can be worked out. It is also satisfactory to know that many of the most opulent and scientific of the nobility have liberally afforded funds for its first establishment, though it must be the public upon whom its ultimate success must rest. It is proposed, that any person be admitted upon the payment of a shilling, as they are now at the Zoological Gardens, and many other public exhibitions.

TERMS OF ART.

(Resumed from page 55, and concluded.)

Softening off.—The reducing the too strong edge of a tint, so that it be rendered gradually weaker and weaker, till no edge can be distinguished. The method of effecting this is to cover about three-fourths of the required space with the tint; and, while it is still moist, with another pencil dipped in water, continue to act on the strong edge to be *softened off* in the most convenient direction, till the appearance of color is lost as you approach to the clean part of the paper.

Blending.—A similar process to softening off, where one tint is required to be intermingled with, or rather laid over another tint, as when the warm glow of a sun-set or sun-rise on the horizon is to be imparted to the cold azure tint of the sky, so [illegible]ly exemplified in many of Cuyp's pieces.

[illegible]-in.—The restoring of any accidental [illegible] or inequality in a tint, by neatly and [illegible]ing the unseemly or deficient spots [illegible] pencil, and with a tint accurately [illegible] with the parts to be *picked in.*

Touch.—The application of color to produce character and effect, [illegible] outlines more bold and *free*, lights [illegible] shades darker, distances more remote, [illegible]

Sponging.—This [illegible] is necessary when broad tints have not been evenly distributed, or laid on too strongly; these may be corrected by a sponge softened, and nearly filled with water, passed gently two or three times over the whole of the subject, taking care to cleanse the sponge the

the elevation above the level of the sea, where this tree grows, cannot be less than four thousand feet. The forest was so densely thick and untravelled, that the people who accompanied us were obliged, at almost every step, to cut a way for us through it with their sword-like knives, while the excessive steepness and slippery state of the mountain rendered our advance both tedious and dangerous. However, after a couple of toiling days, we reached the group of sought-for trees, surrounded in all directions by others no less wonderful to look upon than themselves. The natives lost no time in making a deep incision into the bark of one, down to the very wood, from which burst forth the milk, white and limpid as that of the cow, sweet to the palate and accompanied by an aromatic smell, but leaving a strong clamminess on the lips, and, upon the tongue, a slight bitter. In a quarter of an hour, we filled two bottles with the produce of a couple of trees; for as our visit happened to be made during the wane of the moon, instead of its increase, the lacteal fluid did not flow so freely as it is said to do when drawn during the latter-named stage.

"The trunk of the Palo de Vaca measured somewhat more than twenty feet in circumference, at about five feet from the root. This colossal stem ran up to a height of sixty feet, perfectly uninterrupted by either leaf or branch; when its vast arms and minor branches, most luxuriantly clothed with foliage, spread on every side, full twenty-five or thirty feet from the trunk, and rising to an additional elevation of forty feet, so that this stupendous tree was quite a hundred feet high in all. I saw others still larger; but the state of the weather drove us from our position. The leaves, when in a fresh state, are of a deep dark and polished green, nearly resembling those of the laurel tribe, from ten to sixteen inches long, and two or three inches wide."

MATERIALS FOR PAPER.

(Resumed from page 86, and concluded.)

The stalks of the mallow, which grows in such profusion on the sides of hedges, having an upright herbaceous stalk, round leaves, and purple flowers, have been found by more than one individual to be well adapted to the production of paper. A few years back, M. de L'Isle presented to the Academie des Sciences a volume printed on paper made of this material. The celebrated chemists, Messrs. Lavoisier, Sage, and Berthollet, gave their testimony in its favor, considering it likely to prove of great utility as hangings for apartments; it having a natural hue much more solid than can be given by coloring [illegible] might with advantage [illegible] as a ground [illegible] drawings.

Many [illegible] made from [illegible] to convert straw [illegible] material [illegible] manufacture of paper, and several [illegible] endeavored to secure [illegible] the advantages which they considered [illegible] accrue from the discovery of a new process. So late as 1825 a patent was taken out for manufacturing paper from straw; but the plan pursued was extremely similar [illegible] which had been previously adopted, and [illegible] had failed. The paper hitherto produced from [illegible] always been extremely harsh, coarse, [illegible] and but little fitted for any useful

Judging from all the trials which have hitherto been made, there is little question that linen rags form the very best material for paper; those of cotton can indeed now be applied to the same purpose with nearly equal advantage; the vast quantity of these rags of all descriptions which are now available to the purpose, renders the adoption of any other material of little moment; but should any unforeseen circumstances hereafter cause a scarcity of linen and cotton rags for the production of this most essential article of civilized life, it is plain that we are surrounded by vegetable substances which are convertible into most valuable substitutes. That part of hemp and flax which is thrown away as refuse, because it is too rough and short for spinning, and which in general amounts to a large proportion of the whole, may, if properly prepared and bleached, be made into as good paper as the most valuable part of the plant, after it has been converted into cloth, and worn for years.

The bine of hops likewise makes a very good material for paper. It is calculated that the stalks of the hops grown in Kent, Sussex, and Worcestershire, and which, after the flowers have been plucked, are now thrown away as useless, would supply materials for the manufacture of all the paper consumed in England.

Paper has recently been fabricated in France from the liquorice root, or the root of the *glycyrrhiza germanica*. It is said that this paper is very white, and does not require any size in its preparation, while it can be manufactured at a price much lower than that made from rags.

Many attempts have been made to convert the husk of maize or Indian corn to the same useful purpose. We are told of an excellent paper being prepared at Rimini from the husks of maize, and lately a patent has been obtained in America for a similar application of this material. Both the husks and flag leaves being mixed with certain proportions of alkali and of water, and exposed to a gentle heat for two hours, are converted into a pulp which is managed in every respect like the pulp of rags in the manufacture of paper.

Another patent has been [illegible] taken out in London for the fabrication of a [illegible] of paper, especially applicable to the [illegible] of ships in the manner that tarred brown [illegible] applied. The material is a peculiarly [illegible] moss, which grows abundantly in ditches [illegible] low grounds of Holland. In that country, and in several of the northern states of G[illegible] from this plant is employed as [illegible] bottoms of ships, between [illegible] eating, and is found to [illegible] preventing [illegible] quality it [illegible] under [illegible]

[illegible] century) [illegible] made of the [illegible] tree. "The Grand Khan," says the V[illegible], "causes the bark to be stripped from [illegible] mulberry-trees, the leaves of which are used for [illegible] silk-worms, and takes from it that thin inner rind which lies between the coarser bark and the wood of the tree. This being steeped, and afterwards pounded in a mortar, until reduced to a pulp, is made into paper, resembling that which is manufactured from cotton."

At the same time (long before such a medium was thought of in Europe) a paper currency was established in China. The paper of the mulberry-tree

was cut into pieces of different sizes, according to the value they were [illegible] recent, each piece was signed by a number [illegible] officers, and stamped with the [illegible] seal, tinged with vermilion. [illegible] circulated in every part of the [illegible] dominions, no person, at the peril of [illegible] daring to refuse to accept it in [illegible].

The [illegible] the harsh bamboo into so [illegible] and [illegible] is extremely simple. Young shoots, one or two years old, which have attained to only three or four inches in diameter, are generally preferred. The leaves are stripped from the stem, and the thin outer green rind, or parenchyma, is peeled off. They are then cut into pieces four or five feet long, made into bundles, and put into water for maceration. In about ten days they become sufficiently softened. After being washed in pure water they are put into a dry ditch and covered with slaked lime for some days; when taken out of this ditch they are again washed, then cut into filaments, and exposed to the rays of the sun to be dried and bleached. In this state they are boiled in large kettles, and subsequently reduced to a pulp in wooden mortars, by means of a heavy pestle with a long handle, which the workman moves with his foot. Thus prepared, some shoots of a particular plant called *koteng*, having been previously reduced to a glutinous substance, are mixed with the pulp in certain exact quantities, for on this mixture depends the goodness of the paper. The whole is then beaten together in mortars, until it becomes a viscid liquor; this is poured into large receiving vessels. Forms of certain dimensions are then plunged into the semi-fluid, and each brings out sufficient for a sheet of paper. The glutinous substance, thus thinly spread, immediately becomes firm and glossy, and is detached from the form by merely turning down the sheet on the heap of paper already made, and without the interposition of a woollen cloth between each sheet, which is necessarily practised in making other paper. The forms or moulds which bring up this bamboo paper are also made of bamboo. Thin slips are selected and drawn successively through several holes in a steel plate, such as is used by our wire-drawers, until they are reduced to a fine thread. Of this thread the form is composed. In cold seasons, or in the more northern provinces, it is sometimes found necessary to dry the paper. This is done by an ingenious contrivance. A hollow wall, with the two fronts [illegible] has a stove at one of the extremi[illegible] communicating with this stove are carried [illegible] through the whole inner spa[illegible] paper are laid on the surface of the wall, [illegible] they adhere until dry, and are then readily [illegible] with a soft brush. It is requisite to dip [illegible] a solution of alum and isinglass to render them fit for the brush or the pencil.

"The consumption of paper in China," says Father Du Halde, "is so prodigious, that it is not surprising they make it of all sorts of materials; for besides the immense quantity used by the learned and students, and to stock tradesmen's shops, one cannot conceive how much is consumed in private houses; one side of their rooms is nothing but windows of sashes covered with paper; on the rest of the walls, which are of plaster, they paste white paper, by which means they preserve them clean and smooth; the ceiling also is made of frames covered with paper, on which they draw divers ornaments. If it has been justly said that the Chinese apartments are adorned with that beautiful varnish which we admire in Europe, it is also true in the greatest part of the houses there is nothing to be seen but paper; the Chinese workmen have the art of pasting it very neatly, and it is renewed every year."

We are informed by Mr. Barrow, that many old people and children gain a livelihood by washing the ink from useless written paper, which after it has been cleansed is beaten up, boiled to a paste, and re-manufactured into new sheets. Even the old ink washed from these written papers is not lost, for the economical and ingenious Chinese have a method by which they separate it from the water, after which it is put aside and preserved for future use. We learn from the same gentleman that the paper makers of China produce sheets of such dimensions, that a single one will cover the whole side of a moderate sized room.

The natives of Ceylon adopted a less artificial paper, and plucked from one of their trees tablets which have resisted for many ages the ravages of time. These are the leaves of the mountain palm, or *Corypha umbraculifera*, called by the Cingalese the talipot-tree. Some of their sacred records are graven on bronze plates which are neatly bordered with silver, but the books of importance in the Cingalese language, relative to the religion of *Buddha*, are written on laminæ of the leaves of this tree, the characters being engraved upon them with either a brass or an iron style.

Under the native government of Ceylon this gigantic leaf was made a distinctive mark of the gradations of rank, each person being allowed, according to his station, to have a certain number of the talipot leaves folded up in the form of fans borne before him by his servants. These leaves are likewise used by the common people as umbrellas, one outspreading leaf affording sufficient shelter for seven or eight persons. This gigantic production of nature is likewise adapted to many other useful purposes, being very substantial and durable.

The Japanese make an excellent paper from the bark of a species of mulberry-tree. The Tonquinese manufacture paper from silk, and from the rinds of different trees.

The Persians draw materials for their paper from a mixture of cotton and silken rags, which they manufacture into a smooth soft surface, and afterwards polish with a stone or shell. It will not bear ink without polishing.

The Aztecs, or aborigines of Mexico, prepared a kind of paper from the pulpy part of the leaves of the same aloe which yielded them a grateful beverage, and afforded them a strong cordage. Their hieroglyphics were written on this paper, pieces of which, of various thicknesses, are occasionally found in that country, whose unfortunate aborigines have been long exterminated, while there are thus still to be discovered vestiges of their advancement in the peaceful arts.

CLEANING SHELLS.

When shells are perforated by sea-worms, or when any other accidental circumstance occurs to deform a good specimen, it is certainly desirable to use some means to improve it; and for this purpose a cement may be made of fine whitening, flour, and gum; the holes or cranks may be filled up with this

composition, and allowed to dry; it should always be a little above the surface, and cautiously scraped down with a knife; when ridges or striæ can easily be imitated, if necessary, with a file or engraving instrument. The parts thus mended may be colored with common water colors, and then brushed; or if on a smooth shell, polished with the palm of the hand, and afterwards rubbed over with Florence oil, which should be well dried off with a piece of flannel. If this mode is judiciously managed, the specimen may be examined, and the blemish never discovered.

Many shells, even when obtained alive, are incrusted with extraneous matter; the best and safest means of removing this is first to steep them in warm water, and then to scrape them with a knife, or start them off with an engraving tool. A little sand-paper may also be used, but care must be taken not to injure the shell. When as much of the crust is in this way removed, as can with safety be done, recourse should be had to *muriatic acid*, very much diluted with water; by applying this cautiously with a feather, to the places you wish removed, for a very short period, it will soon decompose the extraneous matter. Two minutes at a time is as long as it can with safety be applied, but one minute's application often has the desired effect. It should then be emersed in cold water, and the parts well scrubbed with a nail-brush and soap. Should the crust not be entirely removed this process may be repeated, but the greatest care is to be used not to allow the acid to touch the inside, as it will *instantly* remove the fine enamelled surface. Some are so cautious as to melt bees' wax, and coat the parts of the shell they do not wish touched with the acid.

When water is used too hot in the first process, it often makes the fine polished surface crack in a thousand directions.

After the process of corrosion, some make use of flannel or a brush, and emery or tripoly, to polish the shell. This may be done in cases where the polished insides happen to be touched with the corrosive fluid; but in all instances where the places cleared by the acid are of a white or chalkly appearance, they should be washed over with Florence oil, and then rubbed hard with flannel or a nail-brush. This mode gives the shell the appearance of nature, and at the same time stops the action of the acid, should any remain in the shell, and is of great use in preserving it from decay. It is of infinite use in preserving the epidermis, which often, when it becomes dry from lying in a cabinet, cracks and quits the external surface of the shell. It would not be amiss to rub them over with oil once a year.

The common practice of collectors is, when they obtain a specimen which is a little [illegible] coat it over with a solution of gum [illegible] certainly heightens the colors:-but [illegible] no means natural, and a j[illegible] discover the deception. [illegible] is carried to a great [illegible] almost every shell in their cab[illegible] over with gum arabic, and they all shine with great lustre, even although many of the shells should themselves be dim in a natural state.

Oiling shells has a wonderful effect in restoring their colors, when obscured by the surface being somewhat decomposed and of a chalky appearance. If not too much decomposed, the spots and colors will have all their original freshness. Shells are composed of animal matter and lime, and when they are decomposed, it is from the animal matter being set at liberty by the action of some acid: consequently the application of oil is a substitute for the animal matter which they had lost.

MISCELLANIES.

Subterraneous Passage of Lightning.—On the 28th May, 1824, a tree in Vernon, Connecticut, was struck with lightning. After passing down the tree, and tearing the earth up at its roots, the electric fluid passed "50 or 80 feet under the surface of the earth without following any such substances as commonly guides its course there, as roots, stones, &c. The fluid seems not to have been guided at all by any attracting substances, but to have been carried forward nearly in a straight course by a momentum it had received, through a medium opposing the most powerful resistance—a medium in which it is commonly supposed to be dissipated and lost." The electric fluid left unequivocal traces of its passage through a distance of nearly 50 feet. Through the distance of other 30 feet there can be no doubt of its having passed, as its effects upon a wall were distinct at that distance; and it cannot be supposed that it came out of the ground and leaped 30 feet to the wall. This account is given by Professor Kellogg, in Professor Silliman's Journal, vol. ix. p. 81.

The Poor Man's Barometer.—Both the *convolvulus* and the *pimpernel* (anagallis) fold up their leaves on the approach of wet weather. The latter is called the poor man's weather glass. In the same manner the different species of *trefoil* contract their leaves at the approach of a storm, and have been named the husbandman's barometer. *Chickweed* is another plant which answers the same purpose. When the flower expands boldly and fully, no rain will happen for four hours or upwards: if it continues in that open state, no rain will disturb the summer's day. When it half conceals its miniature flower, the day is generally showery; but if it entirely shuts up or veils the white flower with its green mantle, let the traveller put on his great coat, and the ploughman, with his beast of draught, expect rest from their labour.

QUERIES.

78—How is essence [illegible]? By dissolving musk in spirits [illegible]

[illegible] there [illegible] number of eclipses every year? [illegible]

[illegible] mixed with the other ingre[illegible] of [illegible]?

81—How may discolored pearls be bleached? Let them be in a paste of magnesia and water for from 2 to 24 hours, according to the discoloration. Some persons soak them in lime water.—Ed.

82—How may spadilles be cleaned and bleached? By boiling them for a quarter of an hour in soap suds along with soda; and when thus cleaned they may be soaked for an hour in a very weak mixture of sulphuric—or, still better, muriatic acid and water.—Ed.

83—Is there any method of preserving polished steel from rust? Answered in page 100

84—How is wax extracted from the honeycomb? By boiling and straining it.—Ed

85—How are fumigating pastilles made? Answered in page 127.

WOOD ENGRAVING.

No. 1.

10.

11.

WOOD ENGRAVING.

(Resumed from page 84.)

We proceed to the continued review of Mr. Jackson's splendid work on Wood Engraving—intending at present particularly to allude to the practical instructions given on the art in chapter VIII. hoping thereby to direct still more strongly than before the attention of our readers, not merely to the art itself, but to the only work in the language which considers it in detail; for as to the instruction given upon it, and upon the correlative arts in the Encyclopedias, that is utterly useless, being generally written by those who know nothing whatever upon the subject, whereas it will be recollected that Mr. Jackson is himself one of the very first of our artists in wood. Having already described the tools it is now incumbent upon us to show the manner of using them, and the first thing to be acquired is steadiness of hand; upon this Mr. Jackson says:

"*Engraving of Tints.*—In order to acquire steadiness of hand, the best thing for a pupil to begin with is the cutting of tints, that is, parallel lines; and the first attempts ought to be made on a small block, such as is represented in No. 1, (see cut,) which will allow each entire line to be cut with the thumb resting against the edge. When lines of this length can be cut with tolerable precision, the pupil should proceed to blocks of a larger size. He ought also to cut waved tints, No. 2, (see cut,) which are not so difficult; beginning, as in straight ones, with a small block, and gradually proceeding to blocks of greater size. Should the wood not cut smoothly in the direction in which he has begun, he should reverse the block, and cut his lines in the opposite direction; for it not unfrequently happens, that wood which cuts short and crumbles in one direction will cut clean and smooth the opposite way. It is here necessary to observe, that if a certain number of lines be cut in one direction, and another portion, by reversing the block, be cut the contrary way, the tint, although the same tool may have been used for all, will be of two different shades, notwithstanding the pains that may have been taken to keep the lines of an even thickness throughout. This difference in the appearance of the two portions is entirely owing to the wood cutting more smoothly in one direction than another, although the difference in the resistance which it makes to the tool may not be perceptible by the hand of the engraver. It is of great importance that a pupil should be able to cut tints well before he proceeds to any other kind of work. The practice will give him steadiness of hand, and he will thus acquire a habit of carefully executing such lines, which subsequently will be of the greatest service.

"Wood engravers, who have not been well schooled in this elementary part of their profession, often cut their tints carelessly in the first instance; and when they perceive their defect in a proof, return to their work, and with great loss of time, keep thinning and dressing the lines till they frequently make the tint appear worse than at first.

"When uniform tints, both of straight and curved lines, can be cut with facility, the learner should proceed to cut tints in which the lines are of unequal distance apart. To effect this tools of different sizes are necessary, for in tints of this kind the different distances between the black lines are according to the width of the different tools used to cut them; though in tints of a graduated tone of color, the difference is sometimes entirely produced by increasing the pressure of the graver, and tints of this kind are obtained with greater facility and certainty by this means; though to produce a tint of delicately graduated tone, it is necessary that the engraver should be well acquainted with the use of his tools, and also have a correct eye. The cut, No. 3, is a specimen of a tint cut entirely with the same graver, the difference in the color being produced by increasing the pressure in the lighter parts.

"Straight line tints are used to depict a clear sky—waved lines are generally introduced to represent clouds, as they not only form a contrast with the straight lines of the sky, but from their form suggest the idea of motion. It is necessary to observe, that if the alternate undulations in such lines be too much curved, the tint, when printed, will appear as if intersected from top to bottom, like wicker-work in perpendicular streaks. In executing waved lines it is, therefore, necessary to be particularly careful not to get the undulations too much curved.

"As the choice of proper tints depends on taste, no specific rules can be laid down to guide a person in their selection. In the direction of lines it should always be borne in mind by the wood engraver, and more especially when the lines are not *laid in* by the designer, that they should be disposed so as to denote the particular form of the object they are intended to represent. For instance, in the limb of a figure they ought not to run horizontally, or vertically; conveying the idea of either a flat surface, or of a hard cylindrical form, but with a gentle curvature, suitable to the shape and the degree of rotundity required. A well-chosen line makes a great difference in properly representing an object, when compared with one less appropriate, though more delicate. The proper disposition of lines will not only express the form required, but also produce more *color*, as they approach each other in approximating curves, as in the example, No. 4, (see cut,) and thus represent a variety of light and shade, without the necessity of introducing other lines crossing them, which, ought always to be avoided in small subjects; if, however, the figures be large, it is necessary to break the hard appearance of a series of such single lines by crossing them with others more delicate.

"*Engraving Curved Lines.*—In cutting curved lines considerable difficulty is experienced in not commencing properly. For instance, if in executing a series of such lines as are shown in No. 4, (see cut,) the engraver commences at the upper part, and works towards the bottom, the tool will always be apt to cut through the line already formed, whereas by commencing at the bottom, and working upwards, the graver is always *outside* of the curve, and consequently never touches the lines already cut. This difference ought always to be borne in mind, as, by commencing properly, the work is executed with greater freedom and ease, while the inconvenience arising from slips is avoided. When such lines are introduced to represent the rotundity of a limb, with a break of white in the middle, expressive of its greatest prominence, as is shown in the figure, No. 5, it is advisible that they should be first *laid in*, or drawn, as if intended to be continuous, as is seen in the figure, No. 6, and the part which appears white is lowered, or cut out,

before beginning to cut them, as by this means all risk of their disagreeing will be avoided.

"Clear unruffled water, and all bright and smooth metallic surfaces, are best represented by single lines; for if cross lines be introduced, except to indicate a strong shadow, it gives to them the appearance of roughness, which is not at all in accordance with the ideas which such substances naturally excite. Objects which appear to reflect brilliant flashes of light ought to be carefully dealt with, leaving *plenty of black* as a ground work, for in wood engraving such light can only be effectively represented by contrast with dee *color*.

"*Engraving in Outline.*—The word *outline* in wood engraving has two meanings: it is used, first, to denote the distinct boundaries of all kinds of objects; and, secondly, to denote the delicate white line, that is cut round any figure, or object, in order to form a boundary to the lines by which such figure, or object, is surrounded, and thus to allow of their easier liberation. This last is usually called the *white outline*. As this *white* outline ought never to be distinctly visible in an impression, care ought to be taken, more especially when the adjacent tint is dark, not to cut it too deep, or too wide. In the cut, No. 7, the white outline alone is seen—in the finished cut of the same subject it is not visible, on account of the back ground, and the lights of the figure, being cut away. The proper intention of the white outline is not so much to define the form of the figure, or object, but as a boundary to *other lines* coming against it. The small shaving forced out by the graver becomes immediately released, without the point of the tool coming in contact with the true outline.

"*Engraving of Figures, &c.*—After having cut the white outline of the subject, the next step is to cut a similar white line on each side of the pencilled lines, which are to remain, and form the impression when it is printed. A cut when thus engraved, and previous to the parts which are white when printed being cut away, or, in technical language, *blocked out*, would present the appearance of the cut, No. 8. It is, however, necessary to observe, that all the parts which are to be blocked out, have been purposely retained in this cut, in order to show more clearly the manner in which it is executed; for the engraver usually cuts away as he proceeds all the black masses seen within the subject. A wide margin of solid wood round the edges of the cut is, however, generally allowed to remain till a proof be taken, as it affords a support to the paper, and prevents the exterior lines of the subject from appearing too hard. When the cut is properly cleaned out and blocked away it is then finished, and when printed will appear as in No. 9.

"Sculptures and bas-reliefs of any kind are generally represented by simple outlines, with delicate parallel lines running horizontally to represent the ground."

The above is a summary of the directions which Mr. Jackson gives to amateurs, and they are such as, it is hoped, will induce many an individual to try his hand at wood engraving. Without, however, that acuteness of perception, which instruction cannot give, and that taste which is to be acquired only by a general knowledge of the art of drawing, proficiency in wood engraving can scarcely be expected, but with them, although the learner in proceeding from one subject to another more complicated will doubtless meet with difficulties which may occasionally damp his ardour, yet he will encounter none which will not yield to earnest perseverance. The following are among such remarks as are addressed to those as would attain the art as a profession, but as they are equally applicable to other persons, we insert them as the concluding observations on this valuable process.

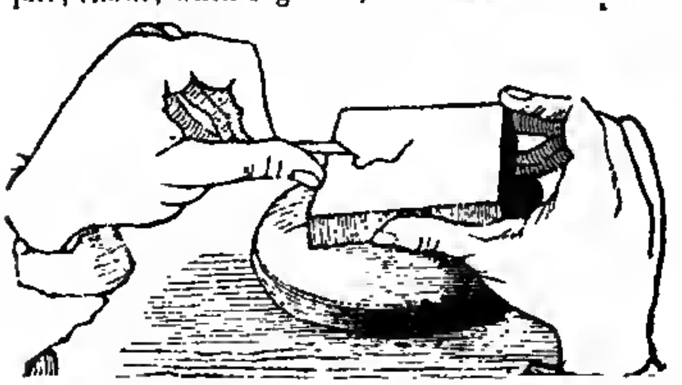
"When comparatively light objects are to be relieved by a tint of any kind, whether darker or lighter, such objects are generally separated from it by a *black* outline. The reason for leaving such an outline, in parts where the conjunction of the tints and the figures does not render it absolutely necessary, is this; as those parts in a cut which appear white in the impression are to be cut away, it frequently happens that when they are cut away *first*, and the tint cut afterwards, the wood breaks away near the termination of the line before the tool arrives at the blank or white. It is, therefore, extremely difficult to preserve a distinct outline in this manner, and hence a black *conventional* one is introduced in those parts where properly there ought to be none. It is necessary to observe further, that when the white parts are cut away before the tint is introduced, the black outline is very liable to be cut through by the tool slipping. This will be rendered more intelligible by an inspection of the cut, No. 10, where the cottage is seen finished, and the part where a tint is intended to be subsequently engraved appears black. Any person in the least acquainted with the practice of wood engraving will perceive, that should the tool happen to slip when near the finished parts, in coming directly towards them, it will be very likely to cut the outline through. When the tint is cut first, as represented in No. 11, the mass of wood out of which the house is subsequently engraved serves as a kind of barrier to the tool in the event of its slipping, and allows of the tint being cut with less risk quite up to the white outline. By attending to such matters, and considering what part of a subject can be most safely executed first, a learner will both avoid the risk of cutting through his outline, and be enabled to execute his work with comparative facility.

"Delicate wood engravings which look well in a proof on India paper, by rubbing the ink partially off the block in the lighter parts, generally present a very different appearance when printed, either with or without types in the same page. Lines which are cut too thin are very liable to turn down in printing from their want of support; and hence cuts consisting chiefly of such lines are seldom so durable as those which display more black, and are executed in a more bold and effective style. A designer who understands the peculiarities of wood engraving will avoid introducing delicate lines in parts where they receive no support from others of greater strength or closeness near to them, but are exposed to the unmitigated force of the press. Cuts in proportion to the quantity of *color* which they display are so much the better enabled to bear the action of the press; the delicate lines which they contain, from their receiving support from the others, are not only less liable to break down, but from their contrast with the darker parts of the subject, appear to greater advantage than in a cut which is a uniformly grey tone. I am not however the advocate of *black* and little else in a wood cut; on the contrary, I am perfectly aware of the absurdity of introducing patches of black without either meaning or effect. What I wish to inculcate is, that a wood cut to have a good effect must contain more of pro-

perly contrasted black and white, than those who wish their cuts to appear like imitations of steel or copper-plate engravings are willing to allow."

We now take our leave of Mr. Jackson for the present; at a future time we may perhaps spare room for a few remarks on *lowering the blocks*, and on engraving maps; at present we have done, but not before cautioning the pupil in the preparative drawing, and directing him how to take a proof of his work, if required, and which Mr. Jackson has omitted.

In drawing it must at all times be remembered that the printing will be the reverse of the drawing, the right side of the one will be the left side of the other; if then a landscape be drawn on wood as it appears in nature, it will not represent it properly when engraved and printed; and so constantly is this the effect, that in drawing for the wood engraver the reins of horsemen, the tools of workmen, &c. must be drawn as if in the left hand; the telescope of the sailor as if held to the left eye; the gun of the sportsman to the left shoulder, &c., in order that when reversed, as they will be when printed, each may appear in its usual and proper position. As an illustration showing the necessity for this we give the following cut, which is a tracing of the one on page 81, which being drawn on ordinary principles, shows, when engraved, a left-handed attitude.



A proof cannot be taken until the principal parts of the subject given are engraved, because of obliterating the design; when a proof is wanted it may be done very easily by means of a little ball-shaped dabber, made of leather with wool withinside. Spread evenly upon this a little printers' ink, dab it carefully on the block, so as to blacken it, but not so much as to fill up the lines with ink; then place a piece of damped paper upon the engraving, and rub the back of the paper with anything hard, which will transfer the ink on to the paper, and constitute a proof, by which the engraver can judge of the progress and effect of his work.

PANORAMAS AND COSMORAMAS.

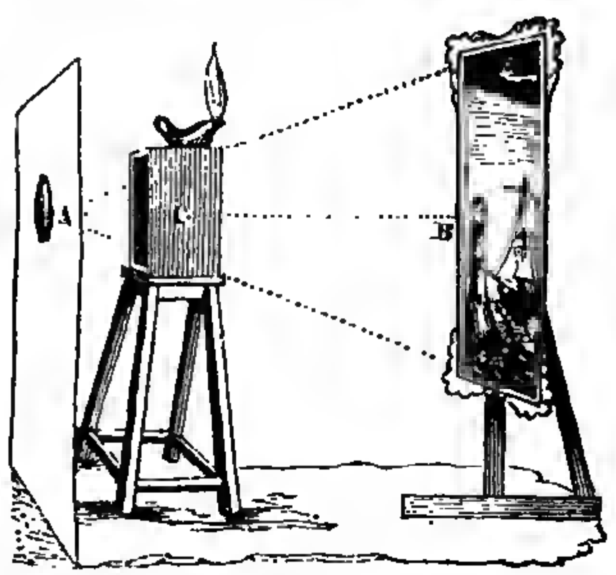
PANORAMAS are cylindrical pictures, the point of view being placed on the axis of the cylinder. By this means the artist is able to represent, on the surface of the cylinder, all the objects of nature which can be seen round a given point as far as the horizon. The name panorama, given to such pictures, signifies *universal view*, because it represents all the objects which can be discovered from a single point. The trace of panoramas is, therefore, nothing else but the intersection of the cylindrical surface forming the picture with one or several conical surfaces, having their summits at the points of view, and for their bases all the lines in nature which the artist proposes to represent.

In order to simplify the work, in painting this species of perspective, the horizon is divided into a great number of equal parts; into twenty, for example. The objects to be represented, which fall within each twentieth part of the horizon, are first drawn in perspective on common plain sheets of paper. On a canvas representing the developement of the cylindrical surface forming the picture, the twenty vertical and parallel bands embracing the whole horizon, or rather the objects contained in each of them, are painted side by side; and finally, the canvas is extended against the cylindrical wall of the rotunda that constitutes the panoramic building.

The truth of this species of representation, when well executed, is so striking, that it frequently produces a belief that the spectator is actually looking at nature itself. No other mode of representation makes us better acquainted with the general aspect of any country round a given point, an advantage not possessed even by a plan in relief, and which the representation of a part of the horizon on a plane surface can never give.

The *Cosmorama* is more simple in construction, and may be formed at less expense and trouble than perhaps any other public exhibition, while it may be varied to infinity.

It consists merely of a picture, seen through a magnifying glass, exactly in the same manner as in the common shows exhibited in the streets for the amusement of children. The difference not being in the construction of the apparatus, but in the quality of the pictures exhibited. In the common shows, coarsely colored prints are sufficiently good, in the Cosmorama a moderately good oil painting is employed. The construction will be readily understood by the following description and cut.



In a hole of a door or partition insert a doubly-convex lens A, having about three feet focus. At a distance from it rather less than the focal distance of the lens, place, in a vertical position, the picture B, to be represented. The optical part of the exhibition is now complete, but as the frame of the picture would be seen, and thus the illusion be destroyed, it is necessary to place between the lens and the view, a square wooden frame, formed of four short boards. The frame, which is to be painted black, prevents the rays of light passing beyond a certain line, according to its distance from the eye, the width of it is such that upon looking through the lens, the picture is seen as if through an opening, which adds very much to the effect, and if that end of the box, or frame,

next the picture have an edge to it, representing the outlet of a cave, a Gothic ruin, or a rocky archway, which might be partially lighted by the top of the box being semi-transparent, the beauty and apparent reality of the picture would be very much enhanced.

Upon the top of the frame is represented a lamp. It is this which illuminates the picture, while all extraneous light is carefully excluded by the lamp being contained in a box, open in the front and at the top.

ANTI-INFLAMMABLE SUBSTANCES.

M. Gay-Lussac some years ago stated that if paper be dipped in a solution of phosphate of ammonia and dried, the inflammability of such paper is destroyed.

We were induced by this observation in the winter of 1836 to prosecute this subject; and at that period, calico, wood, and paper were kept immersed in various saline solutions for days together, in order to ascertain the comparative energy of such solutions in destroying the property of inflammability. As the object of these experiments was altogether practical, those saline solutions only were tried which could be obtained at a sufficiently low rate for general use. Accordingly, for the phosphate of ammonia proposed by M. Gay-Lussac, the muriate was substituted; and this was found to have the greatest effect in destroying the inflammable property of wood, calico, or paper. Wood should remain a week or ten days immersed in a saturated solution of it; for calico and linen twenty minutes; and for paper two or three hours at furthest is sufficient. If either of these be dried after such immersion, and then put into the flame of a candle, they turn black, but do not take fire, and on being removed from the candle they do not continue to keep alight like tinder, ignited as it were, but without flame.

But as neither the muriate of tin nor the muriate of ammonia is sufficiently cheap for extensive use, we are now to examine the fixed alkalies, in reference to the property under consideration.

The subcarbonate of potass, or soda, seems sufficiently efficacious, though not to an equal degree with the salts first mentioned. There is little or no difference in the efficacy of either of these alkalies. They both prevent inflammability: but neither of them prevents ignition, if we may so speak, that is to say, when paper or linen is prepared by them and held in the flame of a candle and then removed, no flame is communicated, but the ignited part or spark continues to spread slowly until the whole of the material is consumed. And this it does, whether the substance be held in one direction or another; though of course the ignited margin extends most quickly when it is held in such a position that it can rise upward. It is to be observed that whether calico, linen, or paper, be soaked twenty-four hours or a week, in solutions of the alkaline subcarbonates, makes little or no difference in reference to this power of ignition. It is hence obvious, that the muriates of tin and ammonia are more decidedly anti-inflammables than the subcarbonates of potass or soda; but it seems not improbable that these latter may retain their powers longer.

As there is little or no difference in the power of these alkalies, and as the latter is now very considerably cheaper than the former, we give it the decided preference.

For practical purposes, the subcarbonate of soda will, except in very particular cases, be found sufficiently anti-inflammable; for no sudden destruction of property which had been prepared by its solution could take place. Fire falling on one of the leaves of a book in a library so prepared, could scarcely be able to extend itself even through the book on which it fell; and certainly could not communicate to other volumes: and whether a child's dress, or the scenes of a theatre so prepared were set on fire, there would be little difficulty in extinguishing it. Although therefore the muriate of ammonia is a more complete anti-inflammable, its great expense compared to subcarbonate of soda is a formidable objection to its general use. Papers saturated with it might sometimes be used instead of parchment, where it was the wish to give the greatest degree of security to the documents or productions.

In reference to wood, muriate of ammonia seems to have no advantage over the subcarbonate of soda. When wood, although cut in the thinnest form, is prepared by the solution of this alkali, the ignited part will not extend, as we have observed is the case with paper or linen under the same circumstances. The subcarbonate of soda then is what we recommend for the preparation of all articles composed of wood.

But it is fair to consider the grand objection to preparing wood by immersion in the saline solutions (for muriate of ammonia is equally liable to this objection with subcarbonate of soda.) The objection alluded to is, that all these saline impregnations are completely removed by immersion in water, or perhaps still more quickly by immersion in solution of soap and water. This was the case equally with muriate of tin, and some other solutions that were tried.

The objection then, just mentioned, will apply to wood that may necessarily be exposed to the rain, or which may require cleaning by soap and water. This is the case with the deck of a ship and the floors of dwelling houses, as at present constructed.

But such seem the principal, or the only exceptions to the general advantage to be derived from the adoption of anti-inflammable wood. A great part of the wood used in building is placed *between* the floors, or on the sides of houses, which are usually painted. In either of these cases wood prepared by subcarbonate of soda will retain its anti-inflammable properties unimpaired.

Of course the preceding remarks, though applicable to all structures of wood, or partially of wood are more particularly so to all offices and premises in which, from the trade pursued, or the number of documents kept in paper, the risk of fire is increased. And not only are they applicable to public and private buildings, but also to ships, and particularly to steam boats.

CHEMICAL SALTS.

The term Salt was originally employed to denote *common salt*, but was afterwards generalized by chemists, and employed by them in a very extensive and not very definite sense. They understood by it any body which is sapid, easily melted, soluble in water, and not combustible; or a class of substances midway between earths and water. Many

disputes arose concerning what bodies ought to be comprehended under the designation, and what ought to be excluded. Acids and alkalies were allowed by all to be salts; but the difficulty was to determine respecting earths and metals; for several of the earths possess all the properties which have been ascribed to salts, and the metals are capable of entering into combinations which possess saline properties. In process of time, however, the term *salt* was restricted to three classes of bodies, viz., *acids*, *alkalies*, and the *compounds* which acids form with alkalies, earths, and metallic oxides. The two first of these classes were called *simple salts*; the salts belonging to the third class were called *compound* or *neutral*. This last appellation originated from an opinion long entertained by chemists, that acids and alkalies, of which the salts are composed, were of a contrary nature, and that they counteracted one another; so that the resulting compounds possessed neither the properties of acids nor of alkalies, but properties intermediate between the two.

Chemists have lately restricted the term *salt* still more, by tacitly excluding acids and alkalies from the class of salts altogether. At present, then, it denotes only the compounds formed by the combination of acids with alkalies, earths, and metallic oxides, which are technically called *bases*. When the proportions of the constituents are so adjusted that the resulting substance does not affect the color of infusion of litmus, or red cabbage, it is then called a *neutral salt*. When the predominance of acid is evinced by the reddening of these infusions, the salt is said to be acidulous, and the prefix *super*, or *bi*, is used to indicate this excess of acid. If, on the contrary, the acid matter appears to be in defect, or short of the quantity necessary for neutralizing the alkalinity of the base, the salt is then said to be with excess of base, and the prefix *sub* is attached to its name.

In the British chemical schools, it is now common to classify the salts in the following orders:—

Order 1st.—The oxy-salts. This order includes no salt in which the acid or base is not an oxydised body. A curious law was observed by Gay Lussac to obtain among the salts of this order. Since all the powerful alkaline bases, with the exception of ammonia, are protoxides of an electro-positive metal, one equivalent of an acid will combine with one equivalent of such a base, and form with it a neutral salt. Now, if we divide the order into families, arranged according to the acid, as sulphates, nitrates, &c., it follows that in each family the oxygen of the salt must bear a constant ratio to the oxygen of the base; thus, since one equivalent of sulphuric acid contains three atoms of oxygen, and one equivalent of nitric acid five, we have the ratio of the oxygen of the acid to the base in the neutral proto-sulphates as three to one, and in the neutral proto-nitrates as five to one. Should the base pass into a higher state of oxidation, as to the state of binoxide, then will it be disposed to unite with two equivalents of the acid; that is, twice the quantity of oxygen forming a bi-salt, still preserving the same ratio of oxygen as in the proto-salts of the same acid and base. This order of salts comprehends the sulphates, double sulphates, sulphites, hyposulphites, hyposulphates, nitrates, nitrites, chloretes, iodates, phosphates, pyrophosphates, metaphosphates, arseniates, chromates, borates, and carbonates.

Order 2nd.—The hydro salts. This order includes no salt the acid or base of which does not contain hydrogen. In this order the hydrochlorides are not included, since the action of the hydrochloric acid acts upon metals and oxides of metals through the agency of the chlorine. The same remark holds with the hydriodic and other hydracids. The only salts included in this order are in fact compounds of the hydracids with ammonia and phosphuretted hydrogen. In some other salts rather as an electropositive ingredient or base than as an acid, and such salts are therefore placed under a different order.

Order 3rd.—Sulphuric salts. This order includes no salt the electropositive or negative ingredient of which is not a sulphuret. The salts of this order are double sulphurets, such as the hydrosulphurets of potassium, sodium, calcium, &c.

Order 4th.—The haloid salts. This order includes no salt the electropositive or negative ingredient of which is not *haloidal*. The salts of this order are double salts, and one or other of the ingredients must be analogous to sea salt, such as the hydrochlorides, aurochlorides, oxychlorides, double iodides, silica fluorides, &c.

As almost every acid unites with every base, and sometimes in several proportions, it follows that the number of salts must be immense. Several thousands are already known, although not above thirty were believed to exist fifty years ago. The early names of the salts, so far as these bodies were known to chemists, were wholly destitute of scientific precision. At present, however, they are universally designated according to the nomenclature of Morvean. The name of each salt consists mainly of two words, one generic, the other specific. The generic word precedes the specific, and is derived from the acid; the specific comes from the base. For example, a salt consisting of *sulphuric acid* and *soda*, is spoken of generically under the name of a *sulphate*, and specifically, by adding the name of the base; thus *sulphate of potash*. The termination *ate* corresponds with the acid whose termination is in *ic*, and the termination *ite* with the acid whose termination is in *ous*; thus *sulphuric* acid gives *sulphates*: *sulphurous* acid, *sulphites*. There are some acids containing less oxygen than those that terminate in *ous*; in such case the word *hypo* is prefixed; thus we have *hypo*-sulphurous acid, *hypo*-nitrous acid, giving also salts that are called *hypo*-sulphites, and *hypo*-nitrites. When the salt is a compound of one atom, or proportional of acid with one of base, it is distinguished simply by the words denoting the acid and the base, without the addition of any prefix. If the salt contains *two* atoms of acid united to *one* atom of base, the Latin numeral adverb *bis* or *bi* is prefixed. Thus *bisulphate of potash* is a salt composed of two atoms sulphuric acid and one atom potash. Were there three, four, &c., atoms acid, the numeral adverbs *ter*, *quater*, &c., would be prefixed. Thus *quater-oxalate of potash* means a compound of four atoms oxalic acid and one acid of potash. When two atoms of base are combined with one atom of acid, this is denoted by prefixing the Greek numeral adverb *dis*. Thus *diphosphate of potash* means a compound of two atoms potash with one atom phosphoric acid. The prefixes *tris*, *tetrakis*, &c., indicate three, four, &c., atoms of base with one atom of acid. Salts of this description were formerly termed *sub-salts*; at least in those instances where an alkaline reaction was produced upon test-liquors from the excess of base.

We have stated above that salts are at present

understood to be compounds only of acids and bases. The discoveries of Sir H. Davy, however, require us to modify this generally received definition. Many bodies, such as common salt and muriate of lime, to which the appellation of *salt* cannot be refused, have not been proved to contain either acid or alkaline matter, but must, according to the strict logic of chemistry, be regarded as compounds of chlorine with metals. Such compounds, possessing, for the most part, the properties of solubility in water, and sapidity, are to be included under the general name of salts. They are denominated *chlorides*, *iodites*, and *bromites*, of the metals, according to the particular constitution of each. Thus the compound of chlorine and calcium, formerly known as muriate of lime, is called the *chloride* of calcium. The solubility of salts in water is their most important general quality. In this menstruum they are generally crystallized; and by its agency they are purified and separated from one another, in the inverse order of their solubility. The determination of the quantity of salt which water can dissolve, is not a very difficult process. It consists in saturating the water exactly with the salt, whose solubility we wish to know, at a determinate temperature, weighing out a certain quantity of that solution, evaporating it, and giving the saline residue.

MISCELLANIES.

Moss.—The humble and apparently insignificant moss is an active agent in some of the most important changes of nature. By its great absorption of moisture, its decay and subsequent revival in succession, the hardest rock, upon which not even a blade of grass could grow, becomes covered in the course of years with a stratum of fertile soil, supporting the most luxuriant trees. At first a little dust is blown into the interstices of the rock, into which are also driven by the winds some of the seeds of the moss from a less sterile spot. Here they vegetate, and the hitherto naked rock becomes covered with pretty green tufts; which spreading wider and wider, year after year, its whole surface is at length covered with the smiling carpet of Nature. The continual growth and decay of the moss and other small plants, gradually increase the thickness of the atrstum, larger plants, the seeds of which are borne from all quarters by the weather; the rotting of these plants continue to add to the soil, till at last are seen to flourish the noblest trees of the forest. Thus, the hard and barren rock is made to abound in the richest products and the grandest vegetation: and thus are the sandy heaths and desert plains converted into verdant and fruitful fields. On the tops of the highest hills and mountains the mosses attract the moisture from the clouds, which trickling through every crevice to find its way to the lowest place, accumulate and form cascades and brooks, which again uniting swell into the largest rivers. These waters flowing into the sea are again raised by the influence of the sun's rays, and form clouds, again to be employed in fertilizing and refreshing the earth. Such is the admirable and unceasing process of Nature.

Paper Nautilus.—"Among the principal miracles of nature," says Pliny, "is the animal called Nautilus, or Pompilos. It ascends to the surface of the sea in a supine posture, and gradually raising itself up, forces out, by means of its tube, all the water from the shell, in order that it may swim the more readily; then throwing back the two foremost arms, it displays between a membrane of wonderful tenacity, which acts as a sail, while with the remaining arms it rows itself along, the tail in the middle acting as a helm to direct its course, and thus it pursues its voyage: and if alarmed at any appearance of danger, takes in the water and descends."

Book of Eternity.—In Signior Castagnetta's account of the asbestos we find a scheme for the making of a book, which, from its imperishable nature, he is for calling the Book of Eternity. The leaves of this book were to be the asbestos paper, the cover of a thicker sort of the same material, and the whole sewed together with thread spun from the same substance. The things to be commemorated in this book were to be written in letters of gold, so that the whole matter of the book being incombustible, and everlastingly permanent against the force of all the elements, and subject to no changes from fire, water, or air, must remain for ever, and always preserve the writing committed to it.

Pyrophori of easy preparation.—It is well known that when 2¼ parts of pure tartaric acid, deprived of its water of crystallization, are quickly mixed in a dry capsule with eight parts of peroxide of lead, perfectly dry and reduced to powder, ignition very soon occurs throughout the mass, which is very vivid and of long duration. This fact, first mentioned by Mr. Walker, would lead to the supposition that other organic substances would undergo similar reaction with peroxyde of lead; and this has been verified by the experiments of M. Bœtliger. On experimenting with the oxalic and citric acids, he found that the action of the former on the peroxyd of lead was more rapid, and perhaps stronger, than that of tartaric acid; while that of citric acid was rather weaker. Thus, on mixing together 5¼ parts of peroxyd of lead, and 1 part of oxalic acid dried in hot air, or containing 19 per cent. of water, almost instantaneous ignition of the mass occurs; but it continues for a much shorter time than with the tartaric acid, because the oxalic acid contains less carbon. In order to obtain a pyrophorus with citric acid, 1 atom of citric acid, previously fused and kept some time in fusion, then dried and pulverized, must be promptly mixed with 2 atoms of peroxyd of lead at the temperature of 73° Fahr. The ignition of the whole mass is almost as vivid, and continues for as long a time, as with tartaric acid. Minium, litharge, and carbonate of lead, mixed with tartaric acid, yield also, according to M. Bœtliger, pyrophori, but not so good as those yielded by pure oxyd.

ANSWERS TO QUERIES.

12—*Why is air always blown from an electrified point?* The air contiguous to an electrified point, being in a similar state of electricity by contact, repels and is repelled by the point, it consequently flies off; when another portion of air immediately fills the vacancy—the constant succession of the repulsion giving rise to the idea of air being blown from the point.—*Zero.*

23—*Whence is the origin of animal heat?* Answered in Page 75.

24—*How may shells be best cleaned?* Answered in Page 95.

36 & 74.—*Why is it that certain ponds, lakes, and rivers, never freeze, even in the coldest winters?* There may be many causes. Some of them may be impregnated with saline matter, as many mineral waters: others may be connected with internal volcanic matter, as the hot springs of Iceland; and others, as Loch Ness, according to Professor Anderson, do not freeze, because, owing to their immense depth, the waters can never be cooled down to the freezing point, or rather to 40°, that being the point at which water is the densest. Could the whole mass be cooled beyond this degree, the chilled water would be retained at the surface, and become, when still farther cooled, frozen—*Ed.*

40 & 42—*What is the cause of solar and lunar halos? Of parhelia, or mock suns, and paraselenæ, or mock moons?*—When light fleecy clouds pass over the sun and moon they are often encircled with one, two, three, or even more, colored rings; and, in cold weather, when particles of ice are floating in the higher regions, the two luminaries are frequently surrounded with the most complicated phenomena, consisting of concentric circles; circles passing through their discs; segments of circles; and *mock suns*, formed at the points where these circles intersect each other. The name *halo* is given indiscriminately to these phenomena, whether they are seen around the sun, or the moon. They are called parhelia when seen around the sun, and paraselenæ when seen round the moon—*Brewster's Optics.*

41—*Hyacinth and narcissus roots grow more rapidly in colored, than in white glasses—Query, the reason?*—The spongioles, or finest fibres of all roots, perish at certain seasons, when the main root becomes dormant, until the stimulus of moisture and warmth combined, again cause them to throw out new fibres. In the dark they have the power of decomposing the moisture into its elements of hydrogen and oxygen, but when exposed to light this abstracts from them the oxygen, which in the first stage of the germination of seeds, as well as in the re-growth of bulbous roots, is necessary for their well-being. When leaves are put forth these organs assist by their action what at first the roots alone had to furnish.—*F. L. S.*

57—*When a shred of camphor is placed on water it swims round in circles, but if a little grease be dropped in it stops, and seeks the side of the vessel. What is the reason of this?* Camphor being a volatile body there is continual emission of its vapour in radii from its centre, consequently those parts in immediate contact with the edge of the water repels, and is repelled by it, giving rise to the peculiar motion observed; but when oil is dropped on the water it instantly spreads over the surface, envelopes the camphor, dissolves it, fills up the pores contiguous to the edge of the water, and thus prevents the emission of its vapour from those parts which is the sole cause of its motion. When camphor is placed on water saturated with camphor it has no motion: for the water emitting camphor vapours, as well as that which floats on it, the two forces balance each other, motion is destroyed, and equilibrium established.—*Zero.*

58—*How can a* [illegible] *be formed from a decoction of cochineal?* [illegible] a solution of alum, 1 part of alum, and 3 of wa[illegible] and to the mixed liquor add a little ammonia, ([illegible]mmon spirits of hartshorn of the shops.) [illegible] be formed a precipitate of alumina and [illegible]

59—*How* [illegible] *clarified?* Answered on Page 88.

61—*How can silver be gilt without the use of mercury?* By two methods: the one called dry gilding. This is done by steeping a linen rag, in a solution of gold in aqua-regis, or nitro-muriatic acid, burning the rag afterwards, and then having the article to be gilt well burnished. A piece of cork is dipped first into a solution of salt and water, then into the black powder, and lastly rubbed over the silver. The second method is called water gilding, which Ure, in his "Dictionary of Chemistry," describes as follows:—The solution of gold may be evaporated till of an oily consistence, suffered to crystallize, and the crystals dissolved in water be employed, instead of the acid solution. If this be copiously diluted with alcohol, a piece of clean iron will be gilded by being steeped therein; or add to the solution about three times its quantity of sulphuric ether, which will soon take up the nitro-muriate of gold, leaving the acid colorless at the bottom of the vessel, which must then be drawn off.

63—*Can gluton be, by any process, made to answer the some purpose as Indian rubber?* Gluten being brittle when dry, and decomposed when moisture is present, it is evident it can never be substituted for caootchouc.

67—*If a thread be twisted tightly round a poker it will not burn, though held in the flame of a candle. Why is this?* Because every body must attain a certain degree of heat before it will burn, and in this case the thread cannot reach that degree, because the heat is carried off immediately by the good conducting powers of the poker.—*Ed.*

68—*What is the construction of the Cosmorama?* Answered in Page 101.

Hardening of Steel Dies.—Mr. Adam Eckfeldt is stated to be the first who employed the following successful mode of hardening steel dies. He caused a vessel, holding 200 gallons of water, to be placed in the upper part of the building, at the height of forty feet above the room in which the dies were to be hardened; from this vessel the water was conducted through a pipe of one inch and a quarter in diameter, with a cock at the bottom, and nozzles of different sizes, to regulate the diameter of the jet of water. Under one of these was placed the heated dies, the water being directed on to the centre of the upper surface. The first experiment was tried in the year 1795, and the same mode has been ever since pursued at the Mint without a single instance of failure.

By this process the die is hardened in such a way as best to sustain the pressure to which it is to be subjected; and the middle of the face, which, by the former process, was apt to remain soft, now becomes the hardest part. The hardened part of the dies so managed, were it to be separated, would be found to be in the segment of a sphere, resting in the lower softer part as in a dish, the hardness of course, gradually decreasing as you descend toward the foot. Dies thus hardened preserve their form till fairly worn out.—*Franklin's Journal.*

QUERIES.

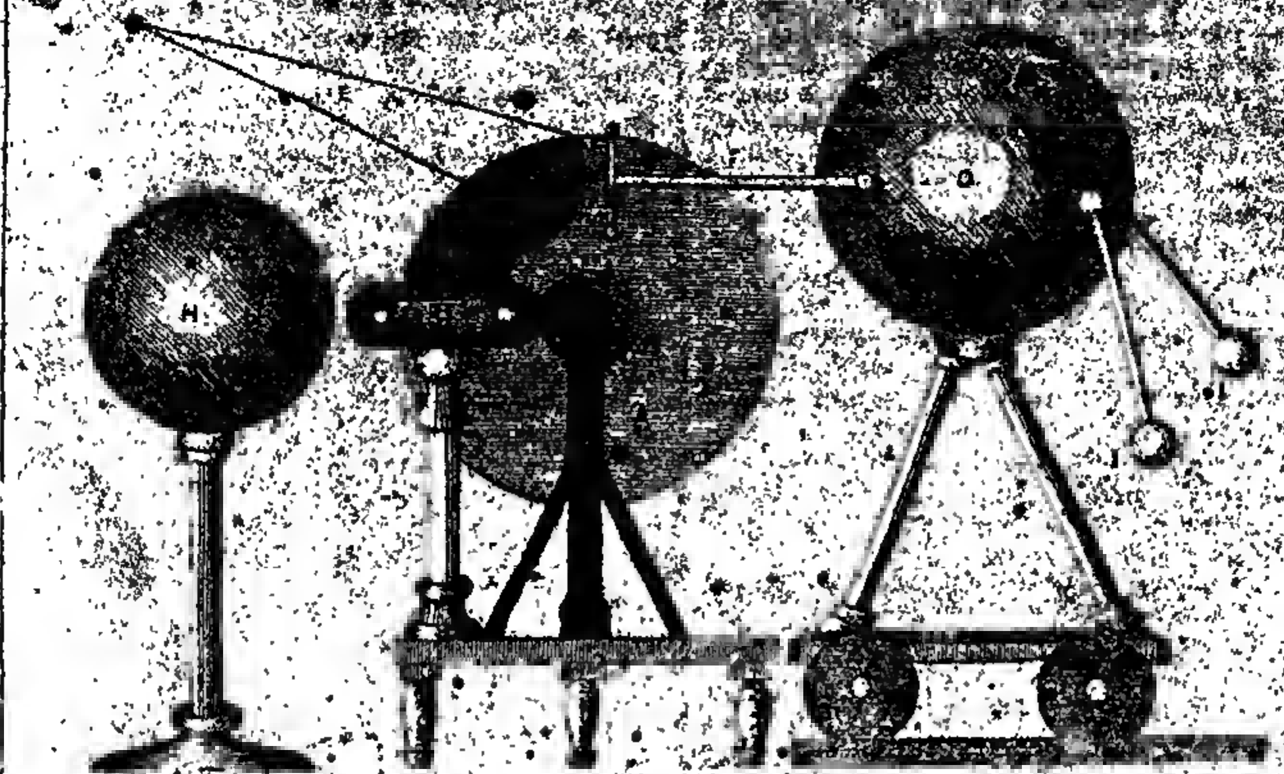
86—Why are eggs coagulated when boiled, and incapable of again assuming the fluid state?

87—What occasions the whistling sound of violent bodies?

88—How are those brilliant colors obtained which we see in chemists' shops?

89—Two balls, each of one pound weight, suspended on separate strings, contiguous, but not touching, showing no inclination to coalesce—at what height from the earth's surface would they [illegible]st attraction for each other.

Fig. 1.



ELECTRICAL MACHINE AT THE POLYTECHNIC INSTITUTION.

(Formerly at the Colosseum, Regent's Park.)

Fig. 3.

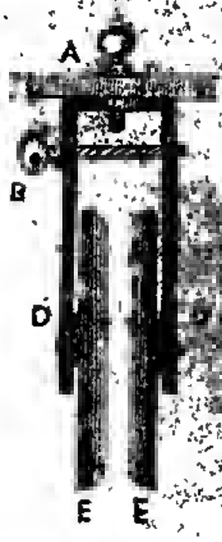


Fig. 2.

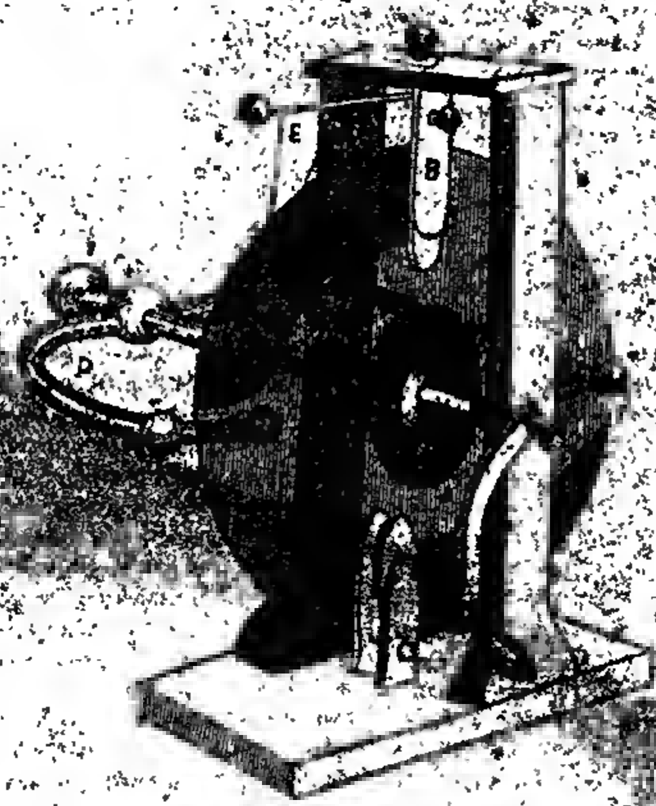


Fig. 4.

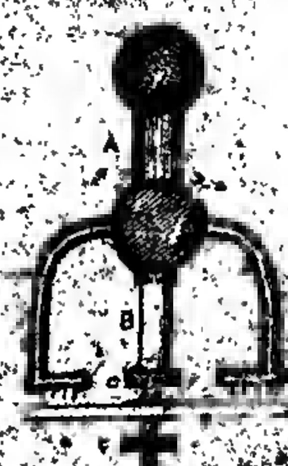


PLATE ELECTRICAL MACHINE.

ELECTRICITY.

(Resumed from page 85.)

In our future experimental researches on electricity, it will be necessary to use a *machine*, for the purpose of accumulating the fluid in greater quantity than the glass tube or such simple means allows, and also of retaining it in such a condensed state as to afford the powerful effects of which it is capable; and we are glad to have the opportunity of describing, at the same time as the ordinary machine, that large and powerful apparatus now exhibiting at the Colosseum, Regent's Park, but lest by this introduction the present article should be too long, we must defer the account of the cylinder machine till another opportunity; as that stupendous one now exhibiting, and which forms the subject of the first engraving, is a modification of that commonly known as the plate machine; or we should, perhaps, with more propriety of arrangement have previously discussed the more common and more easily-constructed and managed apparatus formed with a cylinder of glass, instead of a sheet or plate of that material.

From the last paper it became evident that to excite, accumulate, retain, and transfer the electric fluid, a due knowledge of electrics and conductors is necessary, that the capability of excitation and retention depended upon the quality of the electric; the power of a rapid transmission of the fluids, upon the perfect conducting power of the material, through or over which it is to pass; thus electricians employ for the one purpose chiefly the metals, they being the best conductors; sulphur, resin, and silk as electrics, or as bodies to be excited; and the proper union of these forms an electrical machine.

The usual form of the plate machine is seen in Fig. 2, to which the following description refers:—A is a circular plate of thick glass, supported upon an axis and capable of being turned round vertically by the handle attached to it. This plate in its revolution is rubbed between two narrow cushions on the upper part and two on the lower part of the frame which supports it; these are tightened and loosened by hand screws, and may be removed altogether for cleaning, &c. The cushions being rubbed over with *amalgam*, fixed in their place, and the whole warmed, the machine will be fit for action, as far at least as excitation is concerned. Upon turning the handle, sparks of the electric fluid will be seen to issue from each cushion, and flash to the nearer objects around. To prevent this dispersion, a flap of silk is attached to each cushion and extends some distance along the glass-plate, as seen at C; the two flaps of each pair of cushions being sewn together and somewhat supported by strings attached to a wire at top to keep them in their places. Near where the silk terminates is fixed by a glass rod a brass conductor, furnished with points at the end near the plate, to collect the fluid w[illegible] under the silk, and with a ball at [illegible] end for the convenience of experiments; [illegible] fluid passes upwards from the earth th[illegible] wooden frame to the cushions; it is dra[illegible] to the glass plate; it is retained by the [illegible]; it is collected by the points, poured into the conductor, and there accumulated for use.

To render this clearer, the two principal parts, viz., a pair of the cushions and the conductor, are seen detailed in Figures 3 and 4.

Fig. 3.—A is a screw whereby the cushions are fastened to the frame, B a screw by loosening or tightening of which the pressure is regulated; C the upper part of the frame of the machine; D D the sides to which the cushions are attached; E E the cushions themselves. These may be made to take off; they may be about an inch wide, of a length according to the diameter of the glass plate, covered with leather and padded with four or five folds of flannel, or still better, filled loosely with bran and *steel filings*, the back of them being of metal or of wood.

The silk to be attached to them may be of any texture, a thick sarcenet is most commonly employed for all electrical machines, whether it be oiled or not is of little consequence.

Fig. 4 represents the usual conductor of the plate machine. A is of brass and is called for distinction *the conductor*; it consists of a ball at its extremity connected with a second ball, from which issue two bent metallic tubes, with their ends bent at right angles and furnished with pointed wires. The greatest distance across from one tube to the other is about equal to the diameter of the glass plate of the machine; C is a section of the legs of the stand, showing the glass plate between them; B is a glass rod connecting A to the stand.

From the above description of the usual plate machine, that at the Colosseum will be easily understood; the letters being in both the same. Fig. A represents the glass plate. B a conductor attached to one cushion, a similar one being on the other side; both supported upon glass in order to show that when exhausted of their proper fluid, by turning the winch they indicate negative properties. E two silken strings tying up the silken flaps. F one of two brass rods, with forked ends, to collect the fluid from each side of the glass plate. D the *positive conductor* in which the fluid is collected from the glass; it is supported upon four glass pillars, which are fixed below into a stand, or frame work, capable of being wheeled near, or more distant from the glass. I I two arms projecting from the conductor, for the purpose of being attached to any apparatus near. These move on ball and socket joints, and are terminated by brass balls, which are moved up and down by strings passing through pullies fixed to the sides of the apartment. The glass plate is seven feet in diameter—the larger conductor is a globe of copper, painted black, five feet in diameter. The whole is made with considerable beauty by Mr. Clerke, of the Lowther Arcade. The apparatus connected with it is of equal magnitude—a spiral tube, about te[illegible] long, two batteries of six *carboys* each[illegible]

For a pe[illegible] electricity to observe [illegible] does the whole of a la[illegible] to the walls by cords, [illegible] and wheeled along upon a [illegible] struck with astonishment, and perhaps dread. The electrician would, on the other hand, see but a wasteful expenditure of money, (it must have cost some hundreds of pounds, we understand the glass plate alone cost £100,) and but little of those nice and convenient adaptations to the purposes of experiment which the really scientific man requires. Enormously and uselessly large conductors is the first fault—there being but a *single pair* of cushions, when two pair are used even under ordinary circumstances, is a sad neglect of the double friction, and greatly-increased power that the same plate might have yielded; but the proprietor says, two pair of cushions were intended, and, indeed, made for it, but the friction was so

great that two men could not turn the winch granted—for even now the labor is hard enough; yet would not a glass plate of five feet, instead of seven feet, and with four cushions, have been more useful, more economical, less cumbrous, and more powerful? Then to make electrical batteries of the thick green glass carboys, (used to hold and convey turpentine, &c.) shows such ignorance of the very first principles of the science that we were astonished to see them.

The experiments performed remind us forcibly of the "mountain in labor." The first experiment of taking a spark eight feet long is a very unfair one. The ball is held to the glass plate when in revolution, there being no conductor near it. Now every experimentalist knows that, under these circumstances, a spark may be taken of almost any length, the excited and charged glass itself acting as a partial conductor, the spark will fly from the silk round to cushion again, a totally different thing from taking a spark through the air. The only other experiments exhibited were illuminating the spiral tube, the dancing of pith balls, the Aurora flask, and sending a shock through an iron chain; experiments which might have been performed with a machine of the smallest size, and with equal effect.

ON THE ROTATORY MOTION OF CAMPHOR ON THE SURFACE OF WATER.

BY DR. THOMPSON.

THERE is in science a number of well-known isolated facts, which seem, at first view, to contradict established principles, or, at least, to require for their explanation a train of causes not generally recognised: each fact, therefore, becomes loaded with many theories, and it is difficult to avoid mixing together principles which have really no necessary connexion with the phenomenon, so that the philosopher finds himself frequently unable to give a simple answer to a simple question, "What is the cause of this fact?"

It is possible that our causes are in most cases but removed effects; that is, we explain one effect by another a little more remote, and then the latter is termed a principle, and fairly so, since science does not pretend to teach first causes, but to lead the mind, by slow steps, gradually nearer to the only First Great Cause of all created nature.

The rotation of camp[illegible] on the surface of water has claimed the attention [illegible] eminent philosophers, and excited the [illegible] more humble student.

If a few fragments of [illegible] be thrown on the surface of [illegible] water, [illegible] instantly begin to move, and acquire a mo[illegible] progressive and rotatory, which continues for a considerable time. During these rotations, "if the water be touched by any substance which is at all greasy, all the floating particles quickly dart back, and are, as if by a stroke of magic, instantly deprived of their motion and vivacity."—*Accum.*

The motion of the camphoric particles has been attributed by Lichtenburg to the emanation of an æthereal gas from the fragments of camphor; but he confesses that the cause is involved in considerable obscurity. Venturi supposes that a dissolvent power is excited on the camphor at the common margin of the air and water; he cut pieces of camphor into the form of small columns, an inch in length, and fixed a piece of lead to the base of each column; they were then placed upright in clean saucers, and pure water poured into half the height of the column. A few hours after, a horizontal notch was seen in the column of camphor at the *surface* of the water; and in twenty-four hours the camphor was cut in two at the middle.

Venturi thinks that the camphor at the surface of the water dissolves, and extends over its surface; and by this means coming into contact with a large atmospheric surface, is absorbed and evaporated; the rotatory motion he refers to the mechanical effect of the re-action which the camphoric liquor, extending itself upon the water, exerts against the camphor itself: if the retro-active centre of percussion of all the jets do not coincide with the centre of gravity of the solid camphor, a combined motion of rotation and progression must follow. As the departure of the camphoric solution takes place only at the surface of the water, the rotation is necessarily effected round an axis perpendicular to the horizon.

The theory of Venturi was not considered adequate; and electricity (so commonly the high priest of scientific enigmas) was supposed, by others, to be disturbed the moment the camphor fell upon the surface of the water. Others again thought that the evaporation of the camphor and water explained the cause; and within the last two or three years Matteucci has examined the subject, and thinks that the camphor upon water resembles potassium under similar circumstances; the liberation of hydrogen, and the vapour of water around the floating vessel, producing its rapid motion.

He took rather a large piece of camphor, in order that its motion on water might be slow; under the receiver of an air-pump in a partial vacuum, the movements of the camphor, which were at first very slow, became more rapid, and ceased when the action of the pump was stopped. Matteucci says, "I have observed these phenomena of rotation on water in all volatile bodies. I took raspings of cork, and impregnated them with sulphuric æther; when placed upon water, these small light bodies turned very rapidly." Matteucci's conclusion is, that the rotation of volatile bodies is owing to the currents of their vapours; but this opinion, though published so recently, is by no means new; several years ago M. Biot examined the subject in connexion with an investigation of it by Prevost, and promulgated a similar opinion to that of Matteucci. M. Biot considers that camphor is moved upon the surface of water by the effect of the emission of the particles which compose it; an emission that becomes perceptible to our senses by the smell which it produces, and by the repulsion which it exercises against small bodies floating upon the surface of the water. As the effect resulting from these different impulses does not necessarily pass through the centre of gravity of the piece of camphor, this centre has a motion both progressive and rotatory.

It has been shown by Sir David Brewster, that highly-expansive fluids and vapours are pent up within the cavities and pores of gems and precious stones; and the remark may probably be extended to a large number of solids of a crystalline nature: the composition of this fluid or vapour, in many cases, is probably identical with that of the substance containing it. Now in a porous vaporizable substance, like camphor, the pores are, in all probability, filled with camphoric vapour; and upon placing a thin lamina of the substance upon water,

the substitution of water for vapour in the cavitie occurs as follows:—The minute pores act the par of capillary tubes, and attract the water into them, which water necessarily expels the vapour previoosly existing thereiu; this expulsion of vapour has an effect analogous to that of the jet from a centrifugal pump; that is, to bear the camphor round on a vertical axis. As it is a mere chance whether the forces on opposite sides of the centre of gravity equal each other, the effect, in nearly every instance, is to give the rotatory motion alluded to: sometimes it is both progressive and rototory; then it will suddenly change to a rotation in the opposite direction; all depending on the relative forces of the different little corrents.

Matteucci states, that while the camphor is rotatory, if the vessel be covered with a glass plate, the rotation is stopped; but this is found to be the case to a certain extent ouly; when the vessel containing the camphor is covered, the rotations are lessened, and a general sluggishness pervades all the pieces, and the attraction of the sides of the vessel exerts itself, so that some of the pieces get to the side, and gently oscillate. This may be attributed to the formation of vapour of camphor, which, accumulating between the under-surface of the glass plate and the surface of the water, prevents the fortber liberation of camphoric vapour, and thereby considerably lessens the capillary attraction of the water; but in no case did he get an entire suspension of rotation or movement.

I have succeeded in imparting motion to raspings, or, what is better, to thin slices of cork steeped in sulphuric æther. I think we may apply the same reasoning to this instance as to the former. The slices of cork were steeped in æther for two or three days in a closed bottle; I then placed a few slices on the surface of water, when they rotated for several minutes, and did so, I think, while in the act of exchanging their æther and vapour of æther for water, and the effect ceased when they had no more æther to exchange for water, since it is obvious that in both cases each slice of cork was saturated with a liquid,—*i. e.*, with æther in the first instance, and with water in the second.

I agree with Matteucci in the observation, that under the receiver of an air-pump, while the air is being withdrawn, the gyrations are quicker; but I do not agree that the increased velocity is due to evaporation, but simply to the more copious escape of the camphoric vapour, and the increased capillary action under such circumstances, by which means the pores become filled with water, and the camphor cannot agaio be made to rotate. This increase of emissive force I consider to be due to exactly the same source as the more rapid ebullition of hot water, when deprived, either wholly or partially, of atmospheric pressure.

If the exhaustion be carried on too far, the pieces of camphor are attracted by, and cling to, the interior surface of the vessel, and remain attached thereto at the level of tha water: on re-admitting the air, they instantly recede from the vessel, as if they were repelled by a force; but they do not again rotate. Now, in order to explain this, I must premise that when water is in a vessel whose sides above the fluid level are wetted, the attraction of the glass for the water is auch, that a portion is elevated at the circumference of the liquid surface, so that a vertical segment of the liquid would give a line thus:—

A

The water is elevated at A A, where it is in contact with tha glass, and slightly depressed at B, by virtue of this attraction, as also by atmospheric pressure; a slice of camphor, then, floating upon the liquid surface, is attracted by the sides of the vessel at A A, but this attraction is so slight that, in consequence of the ascent of the fluid at A A, the camphor cannot touch the glass at any one point; but if the atmospheric pressure be at all concerned in slightly depressing the surface at B, and assisting the elevation at A A, it is obvious that the removal of the whole or a part of that pressure will remove the depression at B, and lessen the elevation at A A; the attraction, then, of the sides of the glass for the floating camphor is most fovorably exerted, and consequently they dart to the sides, and there remain, while the re-admission of the air restores the first state of things, and the camphor quits the sides of the vessel for the same reason that a smooth solid slides down an inclined plane.

If the production of the gyrations of the camphor are to be referred to capillary attraction in the first instance, and to the escape of camphoric vapour in the second instance, by whose means currents acting like paddles constitute the moving power, it is obvious that heat would assist the liberation of the vapour, and produce more rapid rotations, whose career would terminate much sooner than at the ordinary temperature of the air. All this I find to be the case.

Pure water was heated to 148°, when the rotations of the camphor were increased in velocity, and ceased entirely in sixty-nine minutes.

Two glasses were set aside, one containing water at 58°, and the other at 210°; several slices of camphor were placed in both at the same time; the camphor in the first glass rotated for above five hours, until all but a very minute portion had evaporated, while the rotations of the camphor in the hot water lasted only nineteen minutes; about half the camphor had passed off, and the remaining pieces, instead of being dull, white, and opaque, were vitreous and transparent, and evidently soaked with water. The gyrations, too, which at first were very rapid, gradually declined in velocity, until they were quite sluggish.

The stilling influence of oil upon waves has become proverbial; the extraordinary manner in which a small quantity of oil instantly spreads over a very large surface of troubled water, and the stealthy manner in which even a rough wind glides over it, must have axcited the admiration of all who have witnessed it. Now it is by the saoe principle that we must account for the "magical" action of a drop of oil in stopping the rotations of the camphor, which action is best shown in the following manner:—Throw soma camphor, both in slicos and in small particles, upon the surface of water, and while they are rotating, dip a glass rod into oil of turpentine, ond allow a single drop thereof to trickle down the inner side of the glass to the surface of the water; the camphor will instantly dart to the opposite point of the liquid aurface, and cease to rotate. This is due to the rapidity with which the oil spreads over the surface of the water, and it is supposed that each particle of camphor becomes surrounded at the water's edge with a minute film of oil, which prevents further contact with the water, and the consequent progress of capillary attraction, and the formation of the currents I have spoken of. If a greasy solid, such as hard tallow or lard, be employed, the motions of

the camphor are more slowly stopped than by oil or fluid grease.

A few drops of sulphuric or muriatic acid gradually stops the camphor's motion, but when camphor is dropped into nitric acid, diluted with its own bulk of water, it rotates rapidly for a few seconds, and then stops. It also rotates in a strong solution of liquor ammoniæ, but not in various solutions of salts. Sublimated benzoic acid rotates upon water, though in a manner far less decided than camphor, and for a much shorter time.

By attentively examining with a lens, and in a good natural light, a piece of camphor while rotating, the currents can be well distinguished jetting out, chiefly from the corners of the camphor, and bearing it round. The motion is by no means equable; sometimes it is slow, when the currents are small and weak, but often very rapid, when they are strong; sometimes a large current will suddenly burst forth, and produce a rapid eccentric motion; it is the irregularity in the force of these currents which causes the fluctuating and flitting changes in the motions for an instant; a balance of force will engender momentary rest, which is, however, immediately disturbed by some new current darting out, and the direction in which it will rotate is always dependent on the aggregate strength of the current at any given spot.

An egg placed in dilute muriatic acid, at first sinks in the solution, but in a few seconds the whole of the egg-shell being covered with bubbles of carbonic acid gas will rise to the surface, a portion of the egg will be lifted above the surface, and the whole egg will slowly rotate upon its prolate axis. This rotation is formed by the bubbles of gas forming at the under part of the egg, and over all the submersed portions, which render them lighter than the portions above the liquid level, and this portion descends as the other ascends. The instances in chemistry of solids moving rapidly through liquids are numerous. Almost any soluble salt, if thrown into a nearly saturated and boiling solution of the same salt, will rotate in dissolving.

The currents as given out by the camphor may also be seen by means of the microscope; a drop or two of pure water may be placed upon a slip of glass, with a particle of camphor floating upon it. By these means the currents will be detected, and it will be seen that they cause the rotations.

Or a flat watch-glass, called a *lunar*, may be employed, raised a few inches, and supported on a ring formed out of a piece of wire, and kept steady by thrusting one end into an upright piece of wood, like a retort-stand. The watch-glass is to contain the water and camphor, and a sheet of white paper is to be arranged below it so as to receive the shadow of the glass, camphor, &c., to be cast by a steady light placed above, and a little on one side of the watch-glass. On observing the shadow, which may be considered a magnified representation of the object itself, the rotations and currents can be distinguished.

It may perhaps be thought that the motion of a bit of camphor is too insignificant to dwell upon; but experimental philosophers know the value of small facts, when viewed as stepping-stones to enlarged and general principles; and the fact that Biot, Prevost, Venturi, and Matteucci, have not thought it beneath them to examine these curious phenomena, will, I hope, furnish a sufficient apology for a more humble labourer in the same field.

NEW PHOTOGRAPHIC PAPER,

IN WHICH THE USE OF ANY SALT OF SILVER IS DISPENSED WITH.

BY MUNGO PONTON, ESQ., F.R.S.E.

When paper is immersed in the bichromate of potash, it is powerfully and rapidly acted on by the sun's rays. When an object is laid in the usual way on this paper, the portion exposed to the light speedily becomes tawny, passing more or less into a deep orange, according to the strength of the light. The portion covered by the object retains the original bright yellow tint which it had before exposure, and the object is thus represented yellow upon an orange ground, there being several gradations of shade, or tint, according to the greater or less degree of transparency in the different parts of the object.

In this state, of course, the drawing though very beautiful, is evanescent. To fix it, all that is required is careful immersion in water, when it will be found that those portions of the salt which have not been acted on by the light are readily dissolved out, while those which have been exposed to the light are completely fixed in the paper. By the second process, the object is obtained white upon an orange ground, and quite permanent. If exposed for many hours together to strong sunshine, the color of the ground is apt to lose in depth, but not more so than most other coloring matters.

This action of light on the bichromate of potash differs from that upon the salts of silver. Those of the latter which are blackened by light, are of themselves insoluble in water, and it is difficult to impregnate paper with them in an equable manner. The blackening seems to be caused by the formation of oxide of silver. In the case of the bichromate of potash, again, that salt is exceedingly soluble, and paper can be easily saturated with it. The agency of light not only changes its color, but deprives it of solubility, thus rendering it fixed in the paper. This action appears to consist in the disengagement of free chromic acid, which is of a deep red color, and which seems to combine with the paper. This is rendered more probable from the circumstance that the neutral chromate exhibits no similar change.

The best mode of preparing paper with bichromate of potash is to use a saturated solution of that salt; soak the paper well in it, and then dry it rapidly at a brisk fire, excluding it from day light. Paper thus prepared acquires a deep orange tint on exposure to the sun. If the solution be less strong or the drying less rapid the color will not be so deep.

A pleasing variety may be made by using sulphate of indigo along with the bichromate of potash, the color of the object and of the paper being then of different shades of green. In this way also, the object may be represented of a darker shade than the ground.

Paper prepared with bichromate of potash is equally sensitive with most of the papers prepared with salts of silver, though inferior to some of them. It is not sufficiently sensitive for the camera obscura, but answers quite well for taking drawings from dried plants, or for copying prints, &c. Its great recommendation is its cheapness and the facility with which it can be prepared. The price of the bichromate of potash is 2s. 6d. per lb. whereas of the nitrate of silver only half an ounce can be obtained for that sum. The preparing of paper

with the salts of silver is a work of extreme nicety, whereas both the preparing of the paper with the bichromate of potash and the subsequent fixing of the images are matters of great simplicity, and I am therefore hopeful that this method may be found of considerable practical utility in aiding the operations of the lithographer.—*Edinburgh New Philosophical Journal.*

ON POLISHING WOOD, IVORY, HORN, AND TORTOISESHELL.

Polishing in the Lathe.—Good work does not require much polishing, for the beauty of it depends more on being executed with tools properly ground, set, and in good order: the work performed by such tools will have its surface much smoother, its mouldings and edges much better finished, and the whole nearly polished; requiring, of course, much less subsequent polishing than work turned with blunt tools. (This is often the case in that done by amateurs and workmen who have not proper conveniences for grinding and setting their tools.)

One of the most necessary things in polishing is cleanliness, therefore previous to beginning it is as well to clean the turning-lathe, or work bench, of all shavings, dust, &c. as also to examine all the powders, lackers, linen, flannel, brushes, &c., which may be required, to see that they are free from dust, grit, or any foreign matter. For further security, the polishing powders used are sometimes tied up in a piece of linen and shaken as through a sieve, so that none but the finest particles can pass.

Although, throughout the following methods, certain polishing powders are recommended for particular kinds of work, it must be understood, that there are others applicable to the same purposes, the selection from which remains with the operator, only observing this distinction, that when the work is rough, and requires much polishing, the coarser powders are best, but, on the contrary, the smoother the work, the less polishing it requires, consequently, the finer powders, in the latter case, are preferable.

Soft wood, though nearly the most difficult material, may be turned so smooth, as to require no other polishing than that produced by holding against it a few fine turnings or shavings of the same wood whilst revolving, this being often sufficient to give it a finished appearance, but, when the surface of the wood has been left rough, it must be rubbed smooth with polishing paper, constantly varying the position of the hand, otherwise it would occasion rings or grooves, (if they may so be called) in the work.

When the work has been polished with the lathe revolving in the usual way, it appears to be smooth, but the roughness is only laid down in one direction, and not entirely removed, which would prove to be the case by turning the lathe the contrary way, and applying the glass paper: on which account, work is polished best in a pole-lathe, which turns backwards and forwards alternately; and therefore it is well to imitate that motion as nearly as possible.

[illegible]gany, walnut, and some other woods, of [illegible] same degree of hardness, may be polished by [illegible] of the following methods:—Dissolve by heat, [illegible] much bees-wax, in spirits of turpentine, [illegible] mixture, when cold shall be of about the [illegible] of honey. This may be applied either to furniture, or to work running in the lathe, by means of a piece of clean cloth, and as much as possible should then be rubbed off by means of a clean flannel, or other cloth. Bees-wax alone is often used; upon furniture it must be melted by means of a warm flat iron; but it may be applied to work in the lathe, by holding the wax against it, until a portion of it adheres, a piece of woollen cloth should then be held upon it, and the lathe turned very quickly, so as to melt the wax, the superfluous portion of which may be removed by means of a small piece of wood or blunt metal, when a light touch with a clean part of the cloth will give it a gloss. A very good polish may be given to mahogany by rubbing it over with linseed oil, and then holding against it a cloth dipped in fine brick-dust. Formerly, nearly all the mahogany furniture made in England was polished in this way.

Hard Woods.—These, from their nature, are readily turned very smooth, fine glass paper will suffice to give them a very perfect surface, a little linseed oil may then be rubbed on, and a portion of the turnings of the wood to be polished may then be held against the article, whilst it turns rapidly round, which will, in general, give it a fine gloss. Sometimes a portion of shell lac, or rather of seed lac, varnish is applied upon a piece of cloth in the way formerly described.

The polish of all ornamental work wholly depends on the execution of the same, which should be done with tools properly sharpened: and then the work requires no other polishing but with a dry hair-brush, to clean it from shavings or dust, this trifling friction being sufficient to give the required lustre.

Ivory, or bone, admits of being turned very smooth, or when filed may afterwards be scraped, so as to present a good surface. They may be polished by rubbing them first with fine glass-paper, and then with a piece of wet linen cloth dipped in powdered pumice stone: this will give a very fine surface, and the final polish may be produced by washed chalk, or fine whiting, applied by a piece of cloth wetted in soap suds. Care must be taken in this, and in every instance where articles of different fineness are successively used, that previously to applying a finer, every particle of the coarser material be removed, and that the rag be clean and free from grittiness.

Ornamented work must be polished with the same materials as plain work, using brushes instead of linen, and rubbing as little as possible, otherwise, the more prominent parts will be injured. The polishing material should be washed off with clean water, and when dry, may be rubbed with a clean brush.

Horn and tortoiseshell are so similar in their nature and texture, that they may be classed together, as regards the general mode of working and polishing them. A very perfect surface is given by scraping, the scraper may be made of a razor blade, the edge of which should be rubbed upon an oil stone, holding the blade nearly upright, so as to form an edge like that of a currier's knife, and which, like it, may be sharpened by burnishing. Work when properly scraped is prepared for polishing, to effect this, it is first to be rubbed with a buff, made of woollen cloth, *perfectly free from grease*, the cloth may be fixed upon a stick, to be used by hand, but what the workmen call a *bob*, which is a wheel running in the lathe, and covered with the cloth, is much to be preferred, on account of the rapidity of the operation: the buff is to be

covered either with powdered charcoal and water, or fine brick-dust and water; after the work has been made as smooth as possible with this, it is followed by another buff, or bob, on which washed chalk, or dry whiting is rubbed; the comb, or other article to be polished, is moistened slightly with vinegar, and the buff and whiting will produce a fine gloss, which may be completed by rubbing it with the palm of the hand, and a small portion of dry whiting, or rotten-stone.

ORGANIC AND INORGANIC KINGDOMS.

The beautiful world in which we are placed, is everywhere full of objects presenting innumerable varieties of form and structure, of action and position; some of them being inanimate or inorganic, and others possessing organization or vitality. The organic kingdom of nature, in like manner, is separated into two grand divisions, the animal and vegetable. The differences between organic and inorganic bodies are numerous and manifest. All the parts of an inorganic body enjoy an independent existence; if a crystal be broken from this mass, the specimen does not lose any of its properties, it is still a mass of crystals as before; but if a branch be removed from a tree, or a limb from an animal, both are rendered imperfect, and the parts removed suffer decomposition—the branch withers, and the animal matter undergoes putrefaction. But if crystals, which may be considered the most perfect models of inorganic substances, be formed, they will continue the same, unless acted upon by some external force of a chemical or mechanical nature. Within, every particle is at rest, nor do they possess the power to alter, increase or diminish: they can augment by external additions only, and decrease but by the removal of portions of their mass. But organic bodies have characters of a totally different nature; they possess definite forms and structures, which are capable of resisting for a time the ordinary laws by which the changes of inorganic matter are regulated, while internally they are in constant mutation. From the first moment of the existence of the plant or animal to the period of its dissolution there is no repose; youth follows infancy—maturity precedes age; it is thus with the moss and the oak—the monad and the elephant—life and death are common to them all. Animals and vegetables also require a supply of food and air, and a suitable temperature, for the continuance of their existence; and they are nourished by particles prepared in appropriate organs, and conveyed by suitable vessels. From the very first germ of an animal or a vegetable, there is a vital principle in action, by which are developed in due ordained phenomena of its existence. By this power the germ is able to attract towards it particles of inanimate matter, and bestow on them an arrangement widely different from that which the laws of chemistry or mechanics could produce. The same power not only attracts these particles, and preserves them in their new situations, but is continually engaged in removing those which might by their presence prevent or derange its operations; and on the other hand, so soon as the vital principle deserts the body which it has animated, the latter immediately becomes subject to the agencies which act on inorganic matter: "in obedience to the power of gravitation the bough hangs down, and the slender stem bends towards the earth—the animal falls to the ground—the pressure of the upper parts flattens those on which they rest—the skin becomes distended, and the graceful outlines of life are changed for the oblateness of death;"—the laws of chemistry then begin to operate—putrefaction takes place—and, finally, dust returns to dust, and the spirit of man to Him who gave it.

MISCELLANIES.

Serpents.—In the savannahs of Isacubo, in Guiana, I saw the most wonderful, the most terrible spectacle that can be seen; and, although it be not uncommon to the inhabitants, no traveller has ever mentioned it. We were ten men on horseback, two of whom took the lead, in order to sound the passages, whilst I preferred to skirt the great forests. One of the blacks who formed the vanguard, returned full gallop, and called to me, "Here, sir, come and see serpents in a pile." He pointed out to me something elevated in the middle of the savannah or swamp, which appeared like a bundle of arms. One of my company then said, "This is certainly one of the assemblages of serpents, which heap themselves on each other after a violent tempest: I have heard of these, but have never seen any: let us proceed cautiously, and not go too near." When we were within twenty paces of it, the terror of our horses prevented our nearer approach, to which, however, none of us were inclined.

On a sudden, the pyramid mass became agitated! Horrible hissings issued from it, thousands of serpents rolled spirally on each other, shot forth out of the circle their hideous heads, presenting their envenomed darts and fiery eyes to us. I own I was one of the first to draw back; but when I saw this formidable phalanx remained at its post, and appeared to be more disposed to defend itself than to attack us, I rode round it, in order to view its order of battle, which faced the enemy on every side. I then sought what could be the design of this numerous assemblage; and I concluded that this species of serpents dreaded some colossal enemy, which might be the great serpent, or the cayman, and that they reunite themselves, after having seen this enemy, in order to attack or resist him in a mass.—*Humboldt.*

Crystallized Tin.—M. Baget, a Frenchman, claims the honor of the discovery of this process. It may be done as follows:—After cleansing away every extraneous matter, as dirt or grease, with warm soapy water, rince the tin in clean water; then, after drying it, give it a heat to the temperature of bare sufferance to the hand, and expose it to the vapour of any acid that acts upon tin, or the acid itself may be poured on, or laid on with a brush, the granular crystallization varying according to the strength of the wash, and the heat of your plates. Hence, it must be perceived, whatever quantity is required for any particular job of work should be made all at one time; no two makings coming away alike, but depending entirely upon accident.

Wash 1. Take one part by measure of sulphuric acid, and dilute it with five times as much water. 2. Take of nitric acid and water, equal quantities, and keep the two mixtures separate.

Then, take of the *first* ten parts, and one part of the *second*; mix, and apply the same with a pencil or sponge to the surface of the heated tin, repeating the same several times, until the material

acted upon loses its heat, or you may be satisfied with the appearance of your work. A transparent varnish is now to be laid on, much whereof will be absorbed, and will of course be affected by any coloring matters you may mix with it; these, however, should not be opaque colors; and a good polish being given to the work, produces that enviably brilliant covering we find so much in use for covering iron story posts, &c.

Temporary Nautical Pump.—Captain Leslie, in a voyage from North America to Stockholm, adopted an excellent mode of emptying water from a ship's hold, when the crew were insufficient to perform that duty. About ten or twelve feet above the pump, he rigged out a *spar*, one end of which projected overboard, while the other was fastened as a lever to the machinery of the pump. To the end which projected overboard, was suspended a water butt, half full, but corked down; so that when the coming wave raised the butt-end, the other end depressed the piston of the pump; but at the retiring of the wave, the thing was reversed, for, by the weight of the butt, the piston came up again, and with it the water. Thus, without the aid of the crew, the ship's hold was cleared of the water in a few hours.

Turkish Glue, or Armenian Cement.—The jewellers of Turkey, who are mostly Armenians, we are informed by that most respectable and intelligent traveller, Mr. Eton, formerly a consul in that country, and author of the celebrated "Survey of the Turkish Empire," have a singular method of ornamenting watch-cases, &c., with diamonds and other precious stones, by simply glueing or cementing them on. The stone is set in silver or gold, and the lower part of the metal made flat, or to correspond with the part to which it is be fixed; it is then warmed gently, and has the glue applied; which is so very strong, that the parts thus cemented never separate; this glue, which will strongly unite bits of glass, and even polished steel, and may of course be applied to a vast variety of useful purposes, is thus made:—Dissolve five or six bits of gum mastic, each the size of a large pea, in as much spirits of wine as will suffice to render it liquid, and, in another vessel, dissolve as much isinglass (previously a little softened in water, though none of the water must be used,) in French brandy or good rum, as will make a two-ounce phial of very strong glue; adding two small bits of gum albanum or ammoniacum, which must be rubbed or ground till they are dissolved. Then mix the whole with a sufficient heat. Keep the glue in a phial closely stopped, and when it is to be used set the phial in boiling water. Mr. Eton observes, that some persons have sold a composition under the name of Armenian cement in England; but this composition is badly made; it is much too thin, and the quantity of mastic is much too small. Good cement made in the manner described is as thick as strong carpenter's glue.

Storm Glasses.—The same as sold by the opticians. Two drachms of camphor, half a drachm of purified nitre, and half a drachm of muriate of ammonia, are to be pulverized and dissolved in two ounces of proof spirits; the mixture is then to be put into a bottle, or tube of glass, about ten inches long, and three-fourths of an inch in diameter, the mouth of which is to be covered with a piece of bladder perforated with a needle. The changes which occur in this composition when left at rest are stated to be of the following nature:—If the weather promise to be *fine*, the solid matter of the composition will settle at the bottom of the glass, while the liquid will remain transparent; but previous to a change for rain the compound will gradually rise, the fluid continue pellucid, and small stars will be observed moving or floating about within the vessel. Twenty-four hours before a storm, or very high wind, the substance will be partly on the *surface* of the liquid, apparently in the form of a leaf: the fluid in such case will be very thick, and in a state resembling fermentation. During the winter, small stars being in motion, the composition is remarkably white, and somewhat higher than usual, particularly when white frosts or snows prevail. On the contrary, in the summer, it the weather be hot and serene, the substance subsides closely to the bottom of the glass tube.

Lastly, it may be ascertained from what quarter of the compass the wind blows, by observing that the solid particles adhere more closely to the bottom on the side opposite to that where the tempest arises.

Sugar from Starch, Wood, &c.—The chemical constituents of these different substances differ but little. The abstraction of a small portion of the carbon and hydrogen from starch converts it into sugar. By digesting potatoes with diluted oil of vitriol for a day or two, at a temperature of 212° Fahr., afterwards removing the acid by chalk, and concentrating the strained liquor by evaporation, crystals of sugar will be obtained. Saussure produced 110 parts of sugar from 100 parts of starch, from which he concluded that sugar was a peculiar compound of water and starch. M. Braconnot treated elm dust with oil of vitriol in the same manner as the starch, neutralizing the acid with chalk, and obtained a liquor which became gummy on evaporation. By triturating linen rags in a glass mortar with sulphuric acid, a similar gum is produced. If the gummy matter is boiled with diluted oil of vitriol, a crystallizable sugar is obtained.

The Light of the Sun and Moon.—The direct light of the sun has been estimated to that of 5,563 wax candles, of moderate size, placed at a distance of *one foot*. The light of the moon is about equal to that of *one* wax candle at the distance of *twelve feet*.

QUERIES.

90—Is there any method of removing stains or yellow spots from books or prints that have been contracted by damp?—*Answered on page 100.*

91—How can finger stains be removed from books, &c.? Alas! alas! that there should be nothing better than Indian rubber.—Ed.

92—What will prevent mouldiness? Any essential oil being kept with the articles. We have found by experience the value of camphor to an herbarium, and if we have a botanist among our readers, we assure him, that a few shreds of camphor strewed among his plants will prevent, not merely the attacks of insects, but the ravages of mould.—Ed.

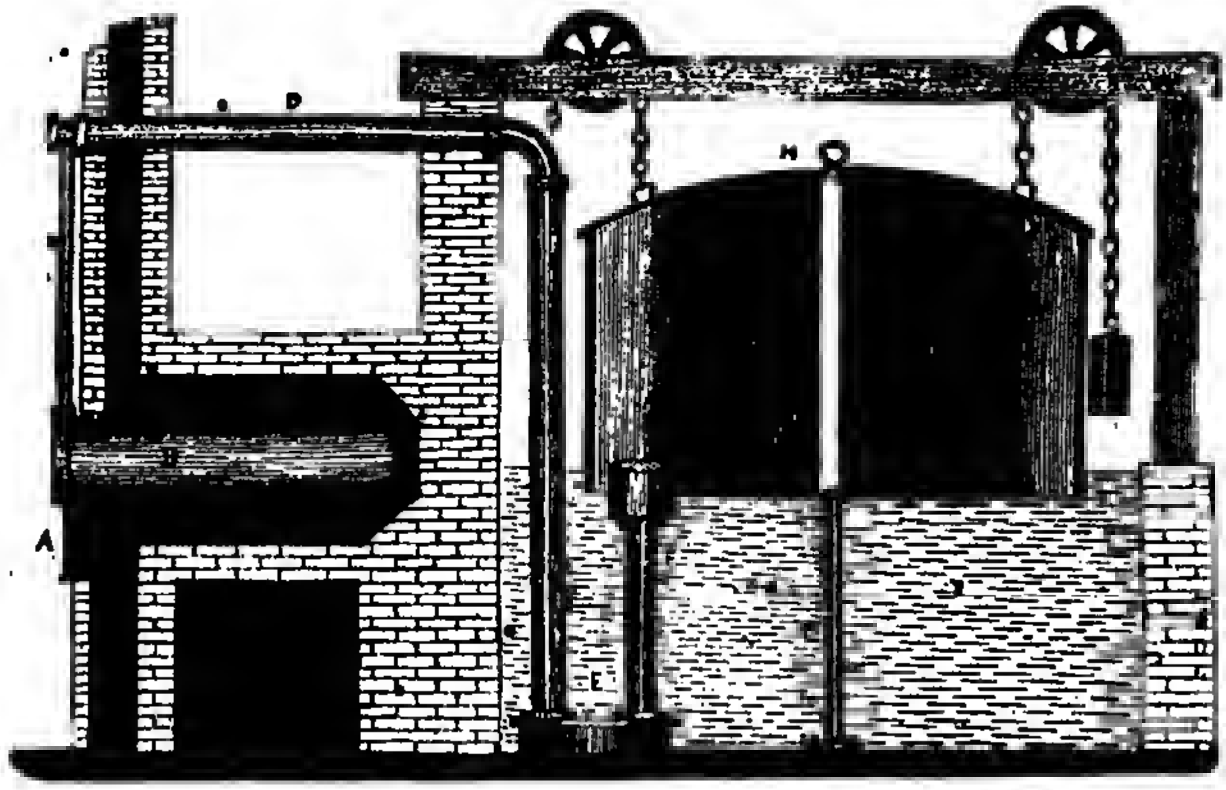
93—How may a good varnish be made for balloons?—*Answered on page 128.*

94—I noticed a few days ago three distinct currents of wind, as indicated by the clouds. Can these contrary currents be accounted for?—*Answered on page 311.*

95—Is the atmosphere ever in such a state that the smoke cannot ascend?—*Answered on page 128*

96—Requested—a receipt for tracing paper, that will bear ink and water color.—*Answered on page 124.*

97—How may seeds be known to be ripe? When seeds are ripe they are always hard, and usually colored.—Ed.



APPARATUS FOR THE PREPARATION OF COAL GAS.

The art of lighting houses, streets, and manufactories, with carburetted hydrogen, or coal gas, is one of those modern discoveries on which the admirers of science, and the inhabitants of this country in particular, have greater reason to congratulate themselves than any other invention or discovery of the present age.

This art is so wonderful and important, it speaks so forcibly by the effects it has already produced, that it cannot fail to increase the wealth of the nation by adding to the [illegible] of internal resources, as long as coal continues [illegible] in this island from the bowels of the earth.

For if we estimate the catalogue of human wants which a civilised state of society has introduced, the production and supply of artificial light, holds, next to food, clothing, and fuel, the most important place. We might indeed exist without it, but how large a portion of our lives would in that case be condemned to a state little superior in efficacy to that of the animals around us. The flame of a single candle animates a family, every one follows his occupation, and no dread is felt of the darkness of night.

The progress of the gas manufacture has been within these few years uncommonly rapid. The number of gas-lights, already in use in the metropolis alone, amounts to upwards of 200,000. The total length of mains in the streets through which the gas is conveyed from the gas-light manufactories into the houses more than 400 miles. And it may be truly said, that there is scarcely a large town throughout the three kingdoms which has not its own, and in some towns, more than one establishment, for the manufacture of this valuable product.

The flame produced from coal, wood, turf, oil, wax, tallow, or other bodies, which are composed of carbon, hydrogen, and oxygen, proceeds from the production of carburetted hydrogen gas, evolved from the combustible body when it has arrived at a certain degree of heat, which varies with the material operated upon.

In the common mode of burning coal in a fire-place, or stove, nearly the whole of this inflammable gaseous matter is lost. We often see a flame suddenly burst from the densest smoke, and as suddenly disappear; and if a light be applied to the little jets that issue from the bituminous part of the coal, they will catch fire and burn with a bright flame; so also if a candle be blown out, and while yet fuming held to another candle still alight, the flame will start [illegible] one to the other, being caught by the gas [illegible] the fuming candle. The fact is, that the [illegible] of the carburetted hydrogen gas, capable of [illegible] light and heat, continually escapes up the [illegible], during the decomposition of the coal, [illegible] a small part is occasionally ignited, and exhibits [illegible] phenomena of the flame.

If coal, instead of being burnt in the way now stated, is submitted at a temperature of ignition in close vessels, all its immediate constituent parts may be collected. The bituminous part is melted out in the form of coal tar, there is disengaged at the same time a large quantity of aqueous fluid, contaminated with a portion of oil, and various ammoniacal salts. A large quantity of carburetted hydrogen, carbonic oxide, carbonic acid, and sulphuretted hydrogen, also make their appearance, and the fixed base of the coal alone remains behind in the distillatory apparatus, in the form of a carbonaceous substance, called coke. The products which the coal furnishes may be separately collected in different vessels. The carburetted hydrogen, or coal gas, when freed from the foreign gases, may be propelled in streams out of small apertures, which when lighted may serve as a flame of a candle, and then form what we call a gas light.

In order to apply this mode of procuring light on a large scale, as now practised with unparallelled success in this country, the coal is put into vessels, called retorts, and which are furnished with pipes connected with reservoirs to receive the distillatory products. The retorts are fixed into a furnace, and heated to redness. The heat developes from the coal the gaseous and liquid products, the latter are deposited in receivers, and the former are conducted through water in which quick lime is diffused; by which the carburetted hydrogen gas is purified. The sulphuretted hydrogen and carbonic acid which were mixed with it, become absorbed by the quicklime, and the pure carburetted hydrogen is stored up in a vessel called the gas-holder, and is then ready for use.

From the reservoir in which the gas has been collected proceed pipes, which branch out into smaller ramifications until they terminate at the place where the lights are wanted, and the extremities of the branch pipes are furnished with stop-cocks to regulate the flow of the gas into the burners or lamps.

The Engraving exhibits an apparatus for the preparation of gas from coal. In this case only one retort is used; but in the larger apparatus, used for public accommodation, several retorts are heated by one fire, and of course save a considerable expense of fuel. These retorts are all made of cast iron, and are generally of an elliptical shape.

The coals are introduced into the cast iron retort or cylinder B, which is placed on its side in the furnace A. The retort is then closed by an air-tight metallic plate, which is fastened to it by bolts and nut-screws. The lower part of the retort is preserved from the action of the fire by a larger half cylinder of cast iron, inclosed in brick-work, placed at some distance below it; by which means the heat is more equally distributed to the pit-coal. As the heat applied to the retorts should be of a regular and uniform temperature, that circumstance requires very attentive observation and care: for if it be not sufficiently strong, all the volatile substances will not be disengaged, and should it on the contrary be too intense, the retorts may be injured, as well as the illuminating quality of the gas be so materially diminished as to render it of less value to the consumer. The degree of heat usually employed is that of a cherry redness; and when the coal has remained in the retorts a sufficient length of time for all its gaseous matter to be expelled, the covers being removed from their mouths, the residue, consisting of the coke, is raked out and falls into a receptacle below them, in order to become cold. At large establishments, whenever the coke has been taken out of them, the retorts are not suffered to lose their heat, but are immediately replenished with fresh coal to renew the operation, and this practice is continued till the retorts are either damaged by wear, or some other circumstance may require their removal. The proportion of coal required to heat the retorts is generally about one fifth of the quantity that is put into them, but at present a great deal of coke is used for that purpose.

A cast iron pipe D, called the hydraulic main, proceeds from the upper side of this cylinder to a cast iron receiver, which is situated at the bottom of the well in which the gasometer rises and falls; in this receiver the tar and other condensable products are collected, and are extracted from time to time by means of a pump affixed to it.

From the top of this receiver proceeds another iron pipe F, which reaches to the surface of the water in the well, but which is inserted into an air-holder of about eighteen inches in diameter, and two feet long, made of iron. The lower part of this air-holder is pierced with holes, which serve a double purpose—first, to divide the gas into several small streams, and thus to render it purer by washing it as it passes through the water; and, secondly, it serves as a reservoir of gas, from whence the tar receiver, connecting tubes, and even the retort itself, may be filled with gas whenever an absorption takes place, by the retort being cooled, or otherwise. The gas is discharged from this air-holder into the gasometer H, which is suspended over the well, and rises and falls therein, being balanced by two weights passing over pullies. This gasometer is made of wrought iron plates, luted in the seams, so as to be air-tight, and well painted both within and without: it has an iron pipe made fast in the centre by means of two sets of stays, one at the bottom of the gasometer, and the other at the top. An upright pipe, fixed in the centre of the well, passes up the central pipe of the gasometer when it is depressed in the well. The gas is pressed out of the gasometer through a row of holes at the very top of the central pipe, into that pipe, whence it passes into the centre pipe of the well, which is continued across the well, and up the side, and from thence is branched out to the lamps.

At an early period of the gas manufacture the average quantity of gas produced from a chaldron of coals was scarcely 10,000 cubic feet. Later improvements have produced no less than double the quantity, and as a common-sized gas burner consumes about six cubic feet per hour, a single chaldron of coals will supply a gas burner for 6,666 successive hours, or more than eight months, without intermission. Besides this valuable and abundant production of gas, it yields other materials no less valuable and useful: it will yield one chaldron and a quarter of coke, worth nearly as much as the original coals; also, twelve gallons of tar, saleable at as many shillings, and eighteen gallons of ammoniacal liquor, worth nine shillings, and which, by combination with lime, furnishes the subcarbonate of ammonia, or the smelling salts of commerce.

Although artificial heat is necessary to decompose coals, so rapidly as to make their constituent principles available for the purposes of public utility and individual comfort, yet they appear to undergo a natural decomposition, and evolve gas in such abundance, as to endanger the lives of the miners, for carburetted hydrogen is but another name for *fire-damp*, the dreadful effects of which we have so often reason

to deplore, and of which so terrific an example has so lately and so unhappily occurred, as the public papers have recorded.

THE THERMOMETER.

Few instruments are more generally useful than the one which forms the subject of tha following article: to it we are indebted for every accurate idea relative to temperature. I shall not enter into any detailed account of the invention of the thermometer, but proceed at once to notice it in its perfect state. To construct a thermometer a uniform capillary tube must be selected, having one extremity blown into a bulb the operator taking such a tube, holds it in the flame of a spirit-lamp, when the air being rarified in consequence of its expansion, he dexterously inserts the open end in a vessel containing the fluid metal mercury; as the air in the tube cools, it contracts, and the mercury rises from the pressure of the atmosphere; the next process is to boil the metal in the tube, by which much of it is expelled, together with all the air, and during tha ebullition the open end must be hermetically sealed. It is convenient to leave the tube for some time before we graduate it, as it is found that the atmosphere exercising a pressure on the sides of the bulb causes a slight variation in its capacity. In graduating we must first obtain certain points to start from; for which purpose, plunge the thermometer bulb into boiling water (with certain precautions which will be alluded to,) and note carefully the point to which the mercury rises; this is called the *boiling point*. The next step is to obtain a *freezing point*, which is done by substituting melting ice for boiling water. These fixed points being obtained, nothing remains to be done but to form a scale for the instrument; in this country the scale of Fahrenheit is the one generally employed: Fahrenheit's division is very far from being philosophical, and is much inferior to that of Celsius (the Centigrade) which is used on the Continent; the zero on the former scale is 32° and the space from the freezing to the boiling point is divided into 180 degrees, consequently the boiling point is 212°:* it is conjectured that Fahrenheit obtained his zero from a mixture of snow and salt; it would be of great advantage if the Centigrade scale were adopted in England; however, any division must be merely conventional, for we know nothing of the extremes of temperature; as Professor Graham beautifully expresses himself; "the scale of temperature may be compared to a chain, extending both upwards and downwards beyond our sight; we fix upon a particular link, and count upwards and downwards from that link, and not from tha beginning of the chain."

It may be asked what proofs we have that the dilatations of mercury indicate corresponding increments of temperature; the answer to this question involves several important facts; the dilatations and contractions of solids by changes of temperature are too small to admit of any precision in recognizing them; while on the other hand gases are exactly tha reverse: liquids being intermediate between these two conditions of matter, it is found convenient to use them in the common thermometer, and of all liquids none are so well adapted as the metal mercury for measuring variations of temperature within certain limits; the reasons for this are as follow.—First, the expansions of mercury are proportional, and bear an exact relation to the heat which produces them, and we may prove this by the following simple experiment:—take two parts of water, one at 60° and the other at 100°; on mixing them, the mean temperature should be 80°, and when we test this by the aid of the thermometer we find such to be the case: if the mercury rose above 80°, it would indicate that it followed a progressively increasing rate of expansion, and would consequently unfit it for tha instrument, the very principle of which depends on the fact that the dilatations of mercury are proportional to the intensity of the heat which produces them. Second, the specific heat of mercury is very small, being only 33 compared to water as 1000, hence it has tha property of being quickly heated and cooled, a circumstance which imparts great sensibility to the instrument. Third, the increments of temperature are available from —39°† the point at which mercury freezes to 600°, when it rises in vapour and thus affects the indications, though it does not boil till 662, though at very high temperatures mercury does expand at a progressively increasing rate, any inconvenience which might arise from this is obviated by the circumstance that glass is subject to the same law to a similar extent; so that the relative capacity between the mercury and the glass remained unaltered; the expansion of the one neutralizing the expansion of the other. The thin capillary tube is a beautifully devised measure, as it permits the slightest variation to be noted.

The most important circumstances to be attended to in graduating thermometers are to have the freezing and boiling points determined with scrupulous accuracy; while determining the latter, two circumstances must be attended to; first, that the barometer stands at 29·8 inches, as for every inch of variation the boiling point of water varies 1·76 degree; and, secondly, that the water be pure, and boiling in a metallic vessel, for it is found that this fluid boils at a higher temperature in glass or earthen vessels than it does in metallic ones;—to prove this, take some water in a glass flask, which has just ceased boiling, if we drop in some iron filings ebullition is immediately resumed. The only precaution to be observed in determining the zero is, that the ice or snow be melting; for it is a remarkable fact that water may be cooled down 20 degrees below the freezing point without congelation being determined; hence it is that the melting of ice and not the freezing of water which takes place invariably at 32°. Such is the philosophy of the simple but useful instrument we have now considered. I have described rather how a thermometer, *may be* made than how *it is* made; but anybody following the directions may construct one, and having once determined the fixed points to which I have so fully alluded, nothing is easier than to apply a scale to the instrument, which scale may be divided into any number of degrees.

W. PRESTON.

DIFFERENCE BETWEEN ANIMALS AND VEGETABLES.

When we compare together those animals and vegetables which are considered as occupying the highest stations in each Kingdom, we perceive that they

* The Centigrade scale is, as the name implies, divided into 100 degrees. To reduce Centigrade to Fahrenheit, multiply by 9, divide by 5, and add 32; for as 180:9::100:5. Reaumur's thermometer, used in the North of Germany has 80 degrees, which may be reduced by an analogous process.

† —39° is 71° below the freezing point of water. Degrees below the ascending scale are indicated by the minus sign prefixed to them.

differ from each other in particulars so obvious and striking, as not to admit of question. The horse, and the grass upon which it feeds; the bird, and the tree in which it builds its nest, are so essentially distinct from each other, that we perceive at once that they belong to distinct classes of organic nature. But it is far otherwise when we descend to those animals and plants which occupy the lowest stations in vitality; here the functions to be performed are but few, the points of difference obscure, and it requires a correct knowledge of the laws of organization, and a careful application of that knowledge, to enable us to determine with precision where animal life terminates, and vegetable existence begins. The lichen which grows on the stone, and the flustra attached to the rock, present but little difference to the common observer; both are permanently fixed to the spot on which they grow, from the earliest period of their existence to their dissolution; and in the vegetable dried by the heat of the sun, and in the coralline shrivelled up from the absence of moisture during the ebb of the tide, we might seek in vain for those characters which would assign the one to the vegetable, and the other to the animal kingdom.

The more important character, which animals alone possess, is the faculty of sensation, communicated to animal matter by a nervous system. In vertebrated animals a brain and spinal marrow form the apparatus by which nervous influence is developed.

Thus when any objects come in contact with our fingers we are sensible of their presence, and our fingers are said to possess sensation; if we compress or cut across the nerve which passes from the brain to the finger, this faculty of sensation is suspended or destroyed: the same objects may come in contact with our fingers as before, but no feelings are excited indicating to us its presence. This phenomenon must be familiar, for every one must, in lying or sitting, have compressed the nerve of the arm or thigh, and occasioned a temporary numbness and loss of accurate feeling in the limb. We perceive, then, by our own experience, that the power of feeling is inseparably connected with the presence and condition of the nerves; and that in man, and the higher classes of animals, this nervous influence is transmitted from the brain and spinal marrow.

In examining the other divisions of the animal kingdom, the presence of a nervous system, more or less developed, may be detected: in the animals of the higher orders, nervous filaments can be distinctly traced, from their origin to their distribution, in the various parts to which they communicate sensation. But in proportion as the system of absorbing, secreting, and circulating vessels becomes less, a corresponding diminution takes place in the nervous fibres, till at length both the vessels and nervous filaments elude our finite observation, and we are left to infer from analogy, that, since sensation depends on the presence of the nerves, and the smallest animals evidently possess sensation, a nervous system exists in the minutest monad of animal organization.

In the largest and most perfect examples of the vegetable kingdom, no traces of nerves are perceptible, nor of any substance which can be considered as at all analogous in structure or function; it is therefore concluded, that as vegetables are destitute of nerves, they are likewise wanting in that faculty which in animals we term sensation.

But the nerves not only bestow feeling, they also confer the power of voluntary motion; and, if the construction of the organs to which such nerves proceed be suitable, they enable the animal to effect progression, or, in other words, give it the faculty of changing its situation from one place to another. As we descend in the scale of creation, we find many animals destitute of that power, and living on the same spot from the commencement to the termination of their existence; and all these animals are inhabitants of the waters.

Such, then, are the essential characters of animal existence—an external form gradually developed, with an internal organization possessing circulating vessels for effecting nutrition and support, and capable of attracting and assimilating particles of inorganic matter, combined with a nervous system communicating sensation and voluntary motion; a certain term of existence being assigned to determinate forms—in other words, a period of life and death.

NOTES ON DAGUERRE'S PHOTOGRAPHY.

(From Edin. Phil. Jour.)

CIRCUMSTANCES having led to my being included in a small party of English gentlemen who were lately invited to visit the studio of M. Daguerre, to see the results of his discovery, I had an opportunity of satisfying myself, that the pictures produced by his process have no resemblance to any thing which, as far as I know, has yet been produced in this country; and that, excepting in the absence of color, they are as perfect images of the objects they represent, as are those which are seen by reflection from a highly polished surface. The perfection and fidelity of the pictures are such, that, on examining them by microscopic power, details are discovered which are not perceivable to the naked eye in the original objects, but which, when searched for there by the aid of optical instruments, are found in perfect accordance: a crack in plaster, a withered leaf lying on a projecting cornice, or an accumulation of dust in a hollow moulding of a distant building, when they exist in the original, are faithfully copied in these wonderful pictures.

The subjects of most of the numerous specimens which I saw, were views of streets, boulevards, and buildings, with a considerable number of what may be termed interiors with still life; among the latter were various groups made up of plaster-casts and other works of art. It is difficult to express intelligibly a reason for the charm which is felt in beholding these pictures; but I think it must arise, in some measure, from finding that so much of the effect which we attribute to color, is preserved in the picture, although it consists only in light and shade; these, however, are given with such accuracy, that, in consequence of different materials reflecting light differently, it is easy to recognise those of which the different objects in the groups are formed. A work in white marble is at once distinguished from one in plaster-of-Paris by the translucency of the edges of the one, and the opacity of the other. Among the views of buildings, the following were remarkable:—A set of three pictures of the same group of houses, one taken soon after sunrise, one at noon, and one in the evening; in these the change of aspect produced by the varia-

tions in the distribution of the light, was exemplified in a way which art could never attain to.

One specimen was remarkable, from its showing the progress made by light in producing the picture. A plate having been exposed during thirty seconds to the action of the light and then removed, the appearance of the view was that of the earliest dawn of day; there was a grey sky, and a few corners of buildings, and other objects, beginning to be visible through the deep black in which all the rest of the picture was involved.

The absence of figures from the streets, and the perfect way in which the stones of the causeway and the foot-pavements are rendered, is, at first sight, rather puzzling, though a little reflection satisfies one that passing objects do not remain long enough to make any perceptible impression, and that (interfering only for a moment with the light reflected from the road) they do not prevent a nearly accurate picture of it being produced.

Vacillating objects make indistinct pictures, *e. g.* a person getting his boot cleaned by a decrotteur gave a good picture, except that having moved his head in speaking to the shoe-black, his hat was out of shape, and the decrotteur's right arm and brush were represented by a half-tinted blot, through which the foot of the gentleman was partially visible.

There can be no doubt that, when M. Daguerre's process is known to the public, it will be immediately applied to numberless useful purposes, as, by means of it, accurate views of architecture, machinery, &c., may be taken, which, being transferred to copper or to stone, may be disseminated at a cheap rate; and useful books on many subjects may be got up with copious illustrations, which are now too costly to be attainable: even the fine arts will gain, for the eyes accustomed to the accuracy of Daguerrotype pictures, will no longer be satisfied with bad drawing, however splendidly it may be colored. In one department it will give valuable facility. Anatomical and surgical drawings, so difficult to make with the fidelity which it is desirable they should possess, will then be easily produced, by a little skill and practice in the disposition of the subjects and of the lights.

It is a curious circumstance that, at the same time M. Daguerre has made this beautiful and useful discovery in the art of delineation, another Parisian artist has discovered a process by which he makes solid casts in plaster of small animals or other objects, without seams or repairs, and without destroying the model. I am in possession of several specimens of his work, among which are casts of the hand of an infant of six months, so delicately executed, that the skin shows evident marks of being effected by some slight eruptive disease.

JOHN ROBISON.

METEOROLOGY OF THE ANCIENTS.

BY THE SENIOR SECRETARY TO THE METEOROLOGICAL SOCIETY.

(Resumed from page 38.)

I HAVE shown in a very brief manner that the ancients had their enthusiastic cultivators of meteorology, chiefly with regard to foretelling the weather, without however effecting any material progress in a scientific point of view; indeed, it may be doubted whether we know more of meteorology now than was known in the days of Kepler. It is indeed a melancholy fact, that, while astronomy, chemistry, and other sciences made rapid progress, meteorology alone remained stationary, a fact which it seems difficult to account for, except that the true principle of atmospheric change was but little understood—the absence of data—the want of instruments—and the love of dealing rather in the marvellous, than in scientific research; and although of late years innumerable facts have been observed, exceedingly ingenious instruments have been invented to enable observers to record those observed facts with precision, yet it is but too apparent that we are now as far from being enabled to foresee the coming storm, the devastating hurricane, or the destructive earthquake, even for a few days, as were the ancient philosophers of Greece and Rome: nor shall we be surprised at this ignorance of this most important branch of physical science, if we take a glance at only a few of the facts upon which their entire knowledge of the weather rested.

Their researches have been as various as the departments of science which have contributed to increase their growing stock of information. The airy mist that floats aloft, or hangs upon the mountain's brow—the ponderous cloud which rolls slowly along in majestic sublimity—the rosy-colored morning—the purple evening sky—the pale and dimly-shining "Queen of Night," half obscured by thickening vapours, or increasing fogs—the "God of Day," with his fiery disk, all speak a clear and intelligible language to the attentive observer. The wild inhabitants of the forest—the domesticated animal—the feathery songsters, "tenants of the sky"—the hoarse and clamorous croakings of the frog—the loud scream of the flitting bat, as it early seeks its hiding place—the solemn moaning and the restless heaving of old ocean's floods, and the gambols of the finny tribes that people the secret caverns of the deep, each, in a manner peculiarly its own, foretells the coming change. Man himself, "proud lord of the creation," also exhibits feelings of uneasiness, especially during a period of indisposition, and not unfrequently in health, during certain states of the atmosphere, from which we naturally suppose that all animals must be influenced in a similar manner, by the regularity with which the animal functions fulfil their destined purpose, being uncontrolled by intellectual agency. Animals manifest very clearly the results of atmospheric variation, by a corresponding deviation from their accustomed habits. Our knowledge at present is very imperfect respecting the connection between atmospheric changes, and their effects on organized bodies; yet the deviations of many animals from their usual habits have attracted the attention of mankind for ages, and furnished observers with data that are now deserving of particular inquiry. The following will exhibit a few of the most prominent and popular of the ancient superstitions which had their origin in meteorological phenomena; and, first, those that relate to the colors of the sky and the heavenly bodies, the formation of clouds, &c.

Colors of various kinds in the sky and clouds, especially at sun-set, are generally tokens of approaching phenomena. Much red forebodes wind and rain, particularly in the morning; while in evening it sometimes indicates a fine day, particularly if the morning be grey. We have two old proverbs on this phenomenon, both of which originate from the same source: viz.

"An evening red, and a morning grey,
Are sure signs of a fine day."

"Be the evening grey, and the morning red,
Put on your hat, or you'll wet your head."

And, again, the following from the Italians:—

"Serâ rosa e nigro mattino,
Allegra il pellerino."

A greenish color in the sky near the horizon often denotes a continuance of wet weather, while the various tints of purple denote a continuance of fine weather. These appearances may be accounted for from the moist or dry state of the atmosphere, as affecting the rays of the sun, or light in passing through different media — the red ray being more refrangible than any other becomes particularly refracted in a dry atmosphere. The grey morning is produced by a number of lofty patches of cirro-cumulus clouds, a species of cloud considered by meteorologists a favorable indication, and hence, among the rules for judging of the weather by clouds, we find in many old almanacs this couplet:—

"If woolly fleeces strew the heavenly way,
Be sure no rain disturb the summer day."

The absence of vapour on the tops of high mountains is generally considered a favorable omen; while the contrary is looked upon as a certain indication of rain. The Table Mountain at the Cape of Good Hope affords, probably, the best illustration of this prediction of any portion of the globe. When clouds hang upon its summit, which sailors term "the spreading of its table-cloth," they generally precede those frequent storms which render the navigation of the Cape Coast both dangerous and difficult.

EFFECT OF GALVANISM ON MUSCULAR ACTION.

Coleman, a mulatto, who murdered his wife, was executed at New York on Feb. 15, 1839. After the body had hung for about a quarter of an hour it was cut down. Mr. Chilton, and several other scientific men, then operated in the following way on the corpse. The instrument used in these experiments was a newly invented-one, called a Galvanic Multiplier; the whole amount of zinc surface exposed to the acid was about one foot, and yet the shock produced is equal, if not greater, than that of a battery of 100 inch plates.

First Experiment.—The lungs were filled with oxygen gas. The phrenic nerve and eighth pair were dissected in the neck; a metallic piece, having a number of points on it, was placed over the ribs, the points being inserted through the skin. The moment the lungs were filled with the gas, the galvanic current was passed from the nerves at the neck to the diaphragm. The object was to bring about respiration. The effect produced was violent contraction of all the muscles, the chest heaved, but no air appeared to enter the lungs, the head and neck were thrown on one side by the spasm produced.

Second.—The metallic piece was removed from the abdomen, and an incision was made through the cartilage of the seventh rib, one pole of the instrument was placed in the opening, so as to touch the diaphragm; the other was placed on the neck. The effect produced was similar to the first.

Third.—The posterior tibial nerve at the heel was exposed; one pole applied to this the other to the neck. Effect—the muscle of the leg was thrown into action, with convulsive movements of the body.

Fourth.—One pole was held at the tibian nerve —the mouth was then opened, and the other pole put into it. The moment it touched the tongue the teeth became firmly clenched, and held so hard on to the wire as to require considerable force to extricate it. This was repeated several times.

Fifth.—The next experiment was to try the effect produced by merely applying the poles of the instrument to the surface of the body, previously wetting its parts with a saline solution, to render the contact more perfect. The effects on the body appeared quite as great as when the large nerves were touched. The poles of the apparatus were placed in the above manner, one to the leg, the other to different parts of the face. The facial muscles were alternately thrown into action as the different nerves of the face were touched. The effect of this was terrific in the extreme. Every muscle of the grim murderer's countenance was thrown into the most horrible contortions: rage, horror, anguish and despair—the most rapid smiles —the most hideous expressions of contempt and hatred by turns were depicted on his countenance, and gave a fearful wildness to his face, which far surpassed even the most vivid imagination from Fuseli's brain, or Kean's scenic display, that we ever witnessed. Several of the audience were excessively appalled; some left in double quick time, and many confessed, that if they had staid, they certainly should have fainted. At one part of the operations, when the murderer raised his right arm and passed it in different directions, we saw the cheeks of several stout-hearted fellows blanched with fear: and one, whose name we do not wish to mention, actually whispered, "Sure, he has come to life." Above an hour was spent in the experiments, and then the prison was cleared, and the body removed under the directions of the sogeons.

Annals of Electricity.

INSECTS.

Insects are distinguished from other animals by the wonderful changes that all, except those of the seventh class, (aptera, or insects without wings, as spiders, crabs, scorpions, fleas, &c.) pass through.

Ancient writers were not acquainted with the transformation of insects, as appears very plainly by the erroneous suppositions generally entertained; neither was the mystery entirely explained till the latter end of the eighteenth century, when Malpighi and Swammerdam made observations and experiments on insects, under every appearance, and by dissecting them just preceding their changes, were enabled to prove, that the moth and butterfly grow and strengthen themselves, and that their members and formed and unfolded, under the figure of the insect we call caterpillar.

The succession of its transformations are, the larva or caterpillar batched from the egg. From the larva it passes into the pupa, or chrysalis state. From the pupa or chrysalis, into the imago or fly state.

The Eggs.—These vary in number and figure in different species: some are round, others oval; some are cylindrical, and others nearly square; the shells of some are hard and smooth, while others are soft and flexible.

They are found of almost every shade of color, and are alweys disposed in those situatious where the young brood may find a convenient supply of proper food. Some insects deposit their eggs on the oak-leaf, producing there the red gall; others cause e similar appearance on the poplar; the red of protuberances on the willow, and the termination the juniper branches, are produced by like means. The leaves of some plants are drawn into a globular head by the eggs of an insect lodged in them, and many curious circumstances relative to this economy might be noticed if the nature of our plan would permit.

The phryganea, libellula gnat, ephemera, &c. hover all day over the water to deposit their eggs, which are hatched in the water, and remain there all the time they are in the larva form. Many moths cover their eggs with a thick bed of hair which they gather from their bodies, and others cover them with a glutinous composition, which, when dry, protects them from damp, rain, and cold. The wolf-spider carefully preserves its eggs in a silk bag, which it carries on its back, and by some moths they are glued with great symmetry round the smaller branches of trees, or are secreted beneath the bark, and frequently in the crevices of walls.

The Caterpillar.—All caterpillars are hatched from the egg, and when they first proceed from it are small and feeble, but their strength increases in proportion with their size. A distinguishing character of the caterpillar of a lepidopterous insect is not having less than eight, or more than sixteen feet.

The caterpillar, whose life is one continued succession of changes, moults its skin several times before it attains its full growth; those changes are the more singular as it is not simply the skin which is cast off; but with the exuviæ we find the skull, the jaws, and all the exterior parts, both scaly and membranaceous, which compose the lips, antennæ, palpi, and even those crustaceous pieces within the head, which serve as a fixed basis to a number of muscles, &c.

The new organs are under the old ones, as in a sheath, so that the caterpillar effects its change by withdrawing from the old skin when it finds it inadequate to its bulk.

Those caterpillars thet live in society, and have a nest, retire there to cast their exuviæ, fixing the hooks of their feet firmly in the web during the operation. Some of the solitary species spin et this time a slender web, to which they effix themselves. A day or two before the critical moment for its moulting, the insect ceases to eat, end loses its usual activity, the colors gradually become weaker, and the caterpillar more feeble, the skin hardens and withers, the creature lifts up its back, stretches itself to the utmost extent, sometimes elevetes its head, moving it a little from one side to another, and suddenly letting it fall again; near the change, the second and third rings are seen to swell considerably; end by repeated exertions e slit is made on the back, generally beginning on the second or third ring: through this division the new skin may be just perceived by the brightness of its colors; the creature presses through like a wedge, and thereby separates the skin from the first to the fourth ring, which sufficiently enlarges the aperture to edmit the caterpillar through.

The caterpiller commonly fasts a whole day each time after repeating this operation: some caterpillars, in changing their skins, from smooth become covered with hair; while others, that were covered with hair, have their last skins smooth.

The food of caterpillars is chiefly or entirely of the vegetable kind. The larvæ of beetles live under the surface of the earth, and prey upon smaller insects, on the roots and tender fibrils of plants, or on filthy matter in general; indeed, in the last state, beetles are most commonly found in putrid flesh, or in the excrements of animals.

When the caterpillar has attained its full size, and all the parts of the future moth, or butterfly, are sufficiently formed beneath the skin, it prepares to change into the chrysalis or pupa state; some spin webs, or cones, in which they enclose themselves; others descend into the earth and conceal themselves in little cells which they form in the light loose mould; some are suspended by a girdle which passes round the body, and is fastened to the small twigs of trees; and caterpillars of butterflies connect themselves by their posterior extremity to the stalks or leaves of plants with their head downwards.

The length of time insects live in the state of caterpillars is elweys the same in each individual species, yet very few species precisely agree in the same period for their changes; some live two or three years, others only a few months, or even weeks, before they pass to the pupa or chrysalis state.

Preparatory to the change, the caterpillar ceases to take any of its food, empties itself of ell the excrementitious matter that is contained in the intestines, voiding et the same time the membrane which served as a lining to these, and the stomach; and perseveres in a state of inactivity for several ys. At length, by a process similar to its former moulting, the outer skin, or slough, is cast off, and the creature thus divested of its last ekin is what we call the chrysalis.

Pupa, Chrysalis, or Aurelia.—The words aurelia or chrysalis ere equally used to express that inactive state which ensues after the caterpillar has changed, for the great purpose of preparing for the imago, or transformation to the fly. Aurelia, is derived from the Latin *aurum*, and chrysalis from the Greek, end ere both intended to signify a creature formed of gold; this however is giving a general title, from e very partial circumstance, as the color of a considerable number is bleck, or dark brown, while the resplendence of gold is only seen on the chrysalides of e few species of the pepilio, or butterfly. The term chrysalis should therfore be used to signify only those of the butterfly kind, and pupe for the phalænæ, or moths, as well as those of hawk moths.

That very intelligent naturalist M. de Reaumur, expleins the cause of this brilliant eppearance; it proceeds from two skins, the upper one a beautiful brown, which covers a highly-polished smooth white skin: the light reflected from the last, in passing through the uppermost, communicates this bright golden yellow, in the same manner as this color is often given to leather, so that the whole appears gilded, although no gold enters into that tincture.

The exterior part of the pupa is at first exceedingly tender, soft, and pertly transparent, being covered with a thick viscous fluid, but which drying forms e new covering for the enimal.

The time each insect remains in this state is very easily ascertained by those who once breed them, as they elways remain the same space of time, unless forwarded or retarded by heat or cold, but in different

species they vary considerably; for example, the papilio atalanta (red admirable) remained only twenty-one days in chrysalis, from the 12th of July to the 3rd of August, but the phalæna oo (heart moth) remained from the beginning of October till May following; and many species remain a very considerable time longer than this.

When the insect has acquired a degree of solidity and strength, it endeavours to free itself from the case in which it is confined; and as it adheres to a very few parts of the body, it does not require any great exertion to split the membrane which covers it; a small degree of motion, or a little inflation of the body is sufficient for the purpose; these motions reiterated a few times, enlarge the opening and afford more convenience for the insect's escape: this opening is always formed a little above the trunk, between the wings, and a small piece which covers the head. Those species which spin a cone, gnaw or pierce an aperture large enough for their emancipation.

The moth, immediately after emerging from its case, is moist, with the wings very small, thick, and crumpled; but they rapidly expand under the eye of the observer, and in a few minutes have attained their full size; the moisture evaporates, the spots on the wings, which at first appeared confused, become distinct, and the fibres, which were before flexible, become stiff and hard as bones.

When the wings are unfolded, the antennæ in motion, the tongue coiled up, the moth sufficiently dried, and its different members strengthened, it is prepared for flight. The excrementitious discharge which is voided by most insects at this time, M. de Reaumur thinks is the last they eject during their lives.

(*Resumed on page* 131.)

MISCELLANIES.

To make Artificial Coral for Grottos.—To two drachms of fine vermillion add one ounce of clear resin, and melt them together. Having the branches or twigs peeled and dried, paint them over with this mixture while hot. (The sprays from an old black-thorn are best adapted for the purpose, when an irregular branch is required, while the young shoots of the elm tree are altogether as regular. White-thorn and holly-boughs are very natural in shape.) The twigs being painted, hold them over a gentle fire, turning them round till they are perfectly covered and smooth. You may make white coral with white lead, and black with lamp black mixed with the resin, or sealing wax will do for either.

Iodine discovered in various Marine Productions. Soon after the discovery of iodine, Messrs. Gaultier de Claubry and Colin pointed out starch as the most sensible of the re-agents that manifest its existence. It is in fact sufficient to pour an aqueous solution of this vegetable substance into the liquid supposed to contain iodine, to produce immediately a blue color, which arises from the formation of an iodine of starch. M. de Ballard, after improving the means of operating with this re-agent, announces his having discovered iodine in bodies which were not hitherto known to possess it; for example, in various marine mollusca, both naked and testaceous, such as the animals of the genera *Doris*, *Venus*, *Ostrea*, &c., several Polyparia and marine vegetables, *Gorgoniæ*, *Zostera marina*, &c., and, in particular, in the brine of salt-works fed by the Mediterranean. The very small quantity of iodine found in the water of the sea has prevented his determining in what state it exists, but there is reason to suppose that it is in the state of hydriodate.

Vibration of Railways.—Captain Denham has ascertained, that the vibrating effects of a passing laden railway train in the open air extended laterally on the same level 1,110 feet, (the substratum of the positions being the same,) whilst the vibration was quite exhausted at 100 feet when tested vertically from a tunnel.

The tunnel was through a stratum of sandstone-rock: the rails laid in the open air, on a substratum of 12 feet of marsh over sandstone rock. The method of testing was by mercury reflecting objects to a sextant.

Composition of the Atmosphere.—M. A. Chevallier states, that:

1st. In general, the air of Paris and of many other places contains ammonia and organic matters in solution.

2nd. If the water deposited from air (dew) by cooling be examined, it is found to contain ammonia and organic matters.

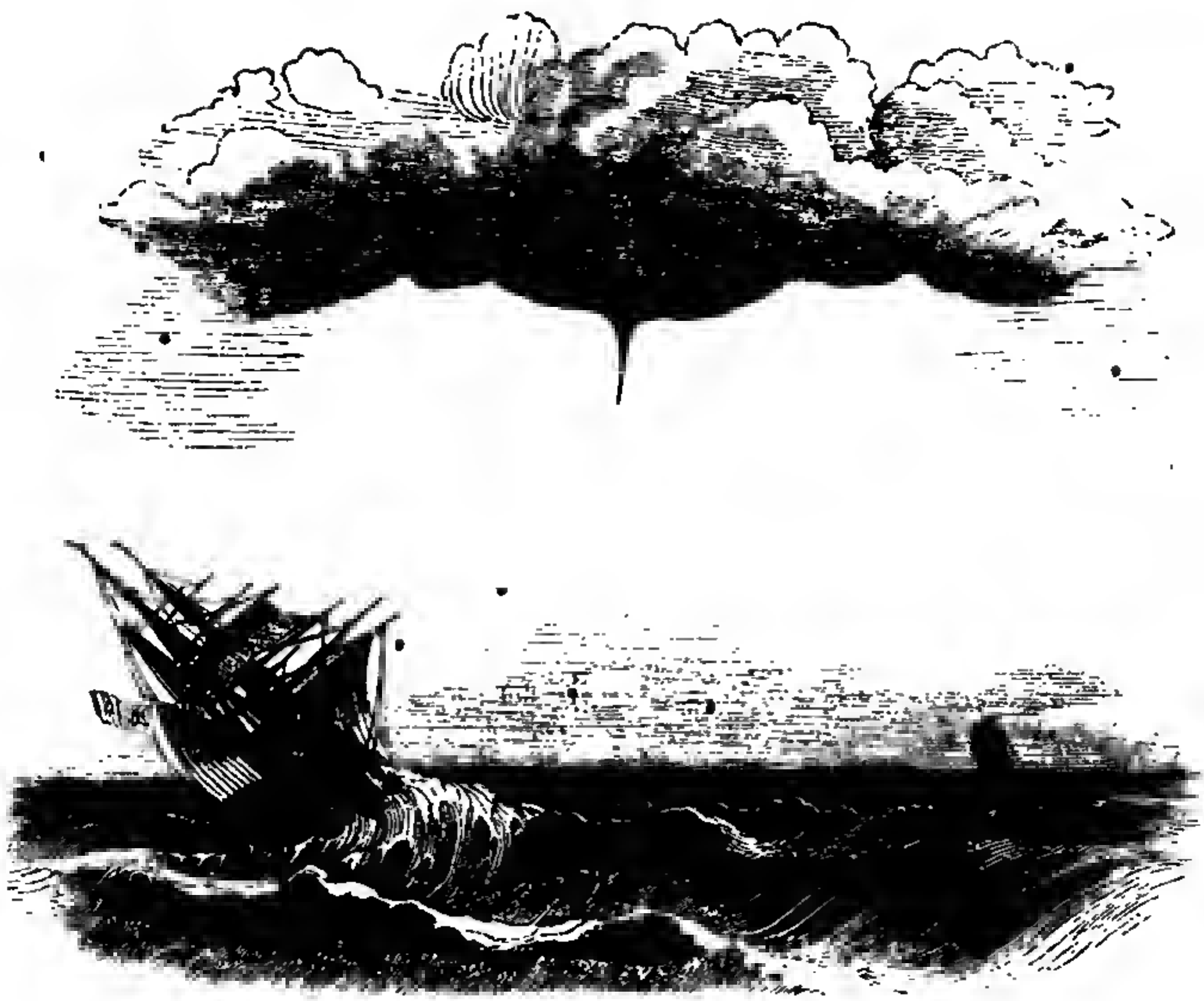
3rd. The quantity of ammonia contained in the air is often pretty considerable.

4th. The presence of ammonia is easily explained, because this gas is produced under many circumstances.

5th. The composition of atmospheric air may vary in certain localities, from a great number of particular circumstances, as the nature of the combustible employed in great masses, the decomposition of animal and vegetable matters, &c. &c. The air of London contains sulphurous acid, that of the sewers of Paris contains acetate and hydrosulphuret of ammonia; air taken near the *bassins* de Montfançon contains ammonia and its hydrosulphuret.

Spontaneous Plants.—Few things are more extraordinary than the unusual appearance and developement of certain plants in certain circumstances. Thus, after the great fire of London in 1666, the entire surface of the destroyed city was covered with such a vast profusion of a species of a cruciferous plant, the *Sisymbrium irio* of Linnæus, that it was calculated that the whole of the rest of Europe could not contain so many plants of it. It is also known, that if a spring of salt water makes its appearance in a spot, even a great distance from the sea, the neighbourhood is soon covered with plants peculiar to a maritime locality, which plants previous to this occurrence, were entire strangers to the country. Again, when a lake happens to dry up, the surface is immediately usurped by a vegetation which is entirely peculiar, and quite different from that which flourished on its former banks. When certain marshes of Zealand were drained, the *Carex cyperiodes* was observed in abundance, and it is known this is not at all a Danish plant, but peculiar to the north of Germany.—In a work upon the useful Mosses by M. de Brebisson, which has been announced for some time, this botanist states that a pond in the neighbourhood of Falain having been rendered dry during many weeks in the height of summer, the mud, in drying, was immediately and entirely covered, to the extent of many square yards, by a minute, compact, green turf, formed of an imperceptible moss, the *Phaseum axillare*, the stalks of which were so close to each other, that upon a square inch of this new soil, might be counted more than five thousand individuals of this minute plant, which had never previously been observed in the country.

No. 1.



WATER-SPOUTS.

No. 2.

WATERSPOUTS, THEIR CAUSE AND APPEARANCE.

Of the different atmospheric phenomena, none are more curious than waterspouts.

That which renders the waterspout so remarkable is the circumstance of a double cone being formed when the phenomena is complete, one cone pointing downwards from a cloud, whilst another points upwards from the sea. The thin semi-transparent columns which stalk, as it were, on the surface of the ocean in calm weather, though no cloud is to be seen above them, as well as the small agitated circles, which are only seen by their marking the smooth surface of the sea in their gyrations, may probably have the same origin as the waterspout. One of these circles, which appeared too insignificant to do harm, after performing many gyrations near a ship commanded by Captain Marquis, on the coast of Malabar, suddenly approached her, as she lay becalmed, with her sails loose, and passing across her bows, carried off her flying jib and jib-boom into the air, higher than the mast-head. I have myself witnessed these semi-transparent columns, within the tropics, without being able to decide which way they turned round; and the spiral form in which they are said to revolve may be the reason; for it is very difficult to pronounce which way a screw revolves when turning rapidly. The figure being double, and the cones pointing in opposite directions, it should be observed whether the cloud above the spout also revolves, and if the gyrations of the upper portion of the phenomenon be in the same, or in the contrary direction to those at the surface of the sea.

Notwithstanding diligent inquiry of a great many persons who witnessed waterspouts at sea, I have only been able to obtain one account in which the gyrations of the wind are satisfactorily explained; and in this instance it proved to be on the surface of the sea, turning in the contrary direction to the apparent law in great storms, in south latitude. The instance alluded to is the waterspout described by Captain Beechey, in the published account of his voyage in the Pacific, when he commanded the Blossom. That account says,—

"While we were off Clermont Tonnerre, we had a narrow escape from a waterspout of more than ordinary size. It approached us amidst heavy rain, thunder, and lightning, and was not seen until it was very near to the ship. As soon as we were within its influence, a gust of wind obliged us to take in every sail, and the topsails, which could not be furled in time, were in danger of splitting. The wind blew with great violence, momentarily changing its direction, as if it were sweeping round in short spirals; the rain which fell in torrents was also precipitated in curves, with short intervals of cessation. Amidst this thick shower, the waterspout was discovered, extending in a tapering form, from a dense stratum of cloud to within thirty feet of the water, where it was hid by the foam of the sea, being whirled upwards by a tremendous gyration. It changed its direction after it was first seen, and threatened to pass over the ship; but being diverted from its course by a heavy gust of wind it gradually receded.

"A ball of fire was observed to be precipitated into the sea, and one of the boats, which was away from the ship, was so surrounded by lightning, that Lieut. Belcher thought it advisable to get rid of the anchor by hanging it some fathoms under water, and to cover the seamen's muskets. From the accounts of this officer and Mr. Smyth, who were at a distance from the ship, the column of the waterspout first descended in a spiral form, until it met the ascending column a short distance from the sea; a second and third were afterwards formed, which subsequently united in one large column, and this again separated into three small spirals, and then dispersed. It is not impossible that the highly-rarified air, confined by the woods encircling the Lagoon Islands, may contribute to the formation of these phenomena.

"The day on which this occurred," continues Capt. Beechey, "had been very sultry, and in the afternoon a long arch of heavy cumuli and nimbi rose slowly above the southern horizon: while watching its movement, a waterspout began to form at a spot on the underside of the arch, that was darker than the rest of the line. A thin cone (No. 1) first appeared, which gradually became elongated, and was shortly joined with several others, which went on increasing in length and bulk until the columns had reached about half down to the horizon. They here united and formed one immense dark-colored tube. The sea beneath had been hitherto undisturbed; but when the columns united, it became perceptibly agitated, and almost immediately became whirled in the air with a rapid gyration, and formed a vast basin, from the centre of which the gradually-lengthening column seemed to drink fresh supplies of water. (No. 2.) The column had extended about two-thirds of the way towards the sea, and nearly connected itself with the basin, when a heavy shower of rain fell from the right of the arch, a short distance from the spout, and shortly after another fell from the opposite side. This discharge appeared to have an effect upon the waterspout, which now began to retire. The sea, on the contrary, was perceptibly more agitated, and for several minutes the basin continued to increase in size, although the column was considerably diminished. In a few minutes more the column had entirely disappeared; the sea, however, still continued agitated, and did not subside for three minutes after all disturbing causes from above had vanished.

"This phenomena was unaccompanied by thunder or lightning, although the showers of rain which fell so suddenly, seemed to be occasioned by some such disturbance.

"The waterspouts were seen in 20° N., and 22° W."—*Abridged from Reid's "Law of Storms."*

ALKALOIDS.

VEGETABLE ALKALIS AND BASES.

The discovery of these substances may be dated from 1817. It was made by Serteurner, but it remained unnoticed or doubted for ten years, till the Institute of France thought proper to pay attention to it. From that time chemists became eager to discover the alkalis of all the plants possessed of any remarkable properties; and substances whose names end in *ine* were multiplied as profusely, and on as slight grounds, as the vegetable acids.

The same mode of preparation is employed for them all. A watery solution of the vegetable matter is evaporated; the base is precipitated by an alkali, that is by boiling it with magnesia; and the vegetable alkaloid is dissolved by pure boiling alcohol, and obtained on cooling, or by distillation. The foreign matters which the precipitate may have carried along

with it are removed either by a diluted solution of potash, or by boiling with a weak acid and animal charcoal, after which the alkaloid is again precipitated by the addition of an alkali.

These substances are *little soluble in water* with the exception of *Curarine* and *Nicotine*. Most of them *restore the color of turnsole reddened by an acid* and *turn the syrup of violets green*. Their taste is, in general, bitter; and they give this bitterness to water, even when it scarcely dissolves an appreciable quantity of them. They unite with acids, and form salts which are much more soluble than their bases; but *their capacity of saturation is very small*. The greater part of them, as well as the salts which they form, are capable of crystallizing; but some of them, when dried, form only gummy masses. Chemists regard these products as the active principles of vegetables, and consequently as natural products of vegetation.

The principal alkaloids are, Morphine, Narcotine, Strychnine, Brucine, Quinine, and Cinchonine, Veratrine, and Emetine.

Morphine.—Discovered by Serteurner in *Opium*. This substance is nearly insoluble in cold water, though it gives it a bitter taste. It is soluble in 100 times its weight of boiling water, and precipitates from this solution as it cools, in the form of small brilliant colorless crystals. Its solution restores the color of turnsole reddened by an acid, and changes the yellow of turmeric to brown. It is soluble in 40 times its weight of pure alcohol when cold, and in thirty times its weight of boiling alcohol. It is soluble also in the fixed and volatile oils and in solution of potash and soda, and to a small degree in ammonia. It is soluble in ether. Hydrochlorate of protoxide of tin precipitates it of a dirty-brown color. Concentrated nitric acid gives it, as well as its salts, a fine red color, which afterwards becomes yellow. The neutral salts of iron give a blue color to it and its salts, which disappears by the action of heat, or of alcohol, acetic ether, or an acid, and is revived on the addition of an alkali. According to Pelletier and Dumas, 100 of this alkaloid saturate 14.84 of sulphuric acid, and, according to Liebig, 75.38 saturate 10.33.

Narcotine.—*This substance is not alkaline*, and it rather dissolves in the acids than combines with them. It is destitute of taste, insoluble in cold water, soluble in 400 times its weight of boiling water, in 100 of cold alcohol, and in 24 of boiling alcohol, in cold ether, and still more so in hot ether, and in the fixed and volatile oils. It does not act on the salts of iron. Concentrated nitric acid colors narcotine of a pale yellow. It is separated from morphine by ether, which does not attack the latter.

Strychnine.—Extracted in 1818 by Pelletier and Caventou from plants of the genus *Strychnos*, and especially from the *Nux Vomica*. It crystallizes by spontaneous evaporation from its alcoholic solution in small white quadrilateral prisms terminated by pyramids. It is alkaline, bitter with a metallic after-taste, does not melt or volatilize by heat, but is decomposed between 593° and 600°. It is soluble in 2500 times its weight of boiling water, and in 6667 of cold water. It is insoluble in ether and pure alcohol but soluble in the volatile oils and to a small degree in the fixed oils as well as in boiling alcohol of sp. gr. .835. It is decomposed by the action of melted sulphur, giving out hydro-sulphuric acid.

Brucine.—Extracted by Pelletier and Caventou from the bark of the *Strychnos Nux Vomica*, and not as had been thought, from the *Brucea Anti-dysenterica*, from which its name is taken. It is soluble in 850 times its weight of cold water and in 500 of boiling water, in pure alcohol, and even in spirit of wine sp. gr. .839. It is soluble also to a small degree in the volatile oils, but insoluble in ether and the fixed oils. It receives a red or yellow color from nitric acid, which is changed by chloride of tin into a fine violet. Strychnine always contains a small portion of brucine.

Quinine and *Cinchonine.*—Cinchonine was discovered almost at the same time by Duncan, Gomez, Lambert, and Pfaff in the bark of the *Cinchona*. Pelletier and Caventou established its alkaline nature, and in the course of their researches on it discovered quinine. The latter is obtained either in masses or powder, while the other is crystalline. Quinine is soluble in 200 times its weight of boiling water, but cinchonine requires 2500 times its weight. It is soluble, to a considerable extent, in boiling alcohol, though less so than quinine. The latter is soluble, to a considerable extent in ether, which is scarcely capable of dissolving the former. Cinchonine is decomposed and partly volatilized by heat without melting. They both form soluble salts with the mineral acids and without acetic acid, and insoluble salts with other acids. The sulphate of quinine is much less soluble than that of cinchonine. Quinine is separated from cinchonine by means of ether or sulphuric acid, or by boiling water. Cinchonine is extracted principally from the pale bark. Both of them are alkaline.

Veratrine.—This substance was discovered at the same time by Meisner, and by Pelletier and Caventou, in the seeds of the *Veratrum Sabadilla* and in the root of the *Colchicum Autumnale*. It is uncrystallizable, alkaline, and possesses a sharp burning taste without any bitterness, but no smell, though strongly sternutatory. It melts at 122°. It is almost insoluble in cold water, but soluble in 1000 times its weight of boiling water. It is very soluble in alcohol and in oil of turpentine by the aid of heat, but insoluble in pure ether.

Emetine.—Discovered by Pelletier in the root of the *Cephaelis Ipecacuanha*. It is of a fawn color, and alkaline. It has a weak bitter taste and no smell. It is difficultly soluble in cold water, but more so in hot water. It melts easily somewhat below 122°. It is very soluble in alcohol, but almost insoluble in ether and the oils. Its salts are as well as itself *uncrystallizable*. The infusion of galls throws it down from its solution in the form of a white precipitate.

It would exceed the limits of this work to give a detailed description of all the proximate alkaloid principles which have encumbered science within the last few years. We shall content ourselves with naming *Curarine*, extracted by Boussingault and Roulin from the *Curara* or *Urali*, a substance which the Indians of South America use for poisoning their arrows; *Esenbeckine*, found by Buchner in the *Esenbeckia Febrifuga*; *Capsicine*, found by Wilting in the *Capsicum Annuum*; *Aconitine* obtained by Peschier from the *Aconitum Napellus*; *Conicine* extracted by Brandes from the *Cicuta virosa* and *Conium Maculatum*; *Crotonine*, extracted by Brandes from the seed of the *Croton Tiglium*; *Buxine*, which Fauré announced his having found in the *Buxus Sempervirens*; *Eupatorine*, which Riphini has discovered in the *Eupa-*

torium Cannabinum; Corticine and *Populine* which Braconnot has found in the bark of the *Populus Tremens;* and, lastly. *Salicine*, which the same chemist and Leroux found in that of the *Salix Alba*, and to which Peschier has directed the attention of physicians as a substitute for quinine. It is extracted by precipitating the tannin from a strong decoction of the bark by means of slaked lime, after which it is to be filtered and evaporated to the consistence of syrup. Alcohol is then to be added, and, after another filtration, by evaporation and cooling, a crystallizable alkaloid is obtained, which is soluble in cold water, and more so in hot water; soluble also in alcohol, but not in ether nor the oils. Sulphuric acid gives it a fine red color. It is not precipitated by an infusion of galls, gelatine, bisulphate of alumina and potash, tartrate of antimony and potash, or acetate of lead. It does not saturate lime water. According to Gay-Lussac and Pelnuze, it is composed of 55.491 of carbon, 36.315 of oxygen, and 8.194 of hydrogen without any nitrogen, and accordingly it is not alkaline.

TRACING PAPERS.

These are of two kinds—first, such as are transparent, and intended to copy any delineation placed beneath them, such as plans, engravings, &c. The other kind is opaque, and used for the purpose of transferring designs, taken upon the first kind of paper, immediately upon a sheet of common paper, block of wood, &c., placed beneath. The following receipts may be useful :—

Common Transparent Paper.—Mix together equal parts of olive oil and turpentine, to which add a little sugar of lead, and rub this mixture upon tissue paper. This is very tedious in drying, and remains greasy for a long period.

2nd *Receipt.*—Lay over the tissue paper a thin coat of copal varnish, or mastic varnish. This makes a clear, good paper, but it will not bear ink or water color. In the latter respect paper washed over with spirit varnish is superior.

3rd *Receipt.*—Rub over one side of a sheet of tissue paper, some poppy oil, or nut oil. This will dry readily, remain perfectly transparent, and not become so soon of a yellow color as some other kinds of paper. It is apt, however, to remain greasy for a considerable time.

Best Transparent Paper.—Mix together by a gentle heat, one ounce of Canada balsam, and a quarter of a pint of spirits of turpentine; wash it as before, over one side of tissue paper. This dries quickly, is perfectly transparent, and is not greasy, therefore does not stain the object upon which it may be placed.

Transparent Guide Paper for Oriental Tinting. Use the mixture of Canada balsam and turpentine, as above, on both sides of a sheet of thick drawing paper; it will become beautifully transparent. It takes some days in drying, and, when new, sticks somewhat to the fingers.

Note.—Ink and water-colors, when to be used upon any kind of transparent oiled paper, must have a very small quantity of *gall* mixed with them, which will make them flow readily upon the greasy surface.

Transparent papers are sold at extravagant prices, notwithstanding the vast consumption there is for them. The architect draws chiefly upon them the numerous designs requisite in his profession. The engraver is by their use enabled to transfer to the wood block or to the metallic plate an accurate design, and at once to reverse it by merely turning over the paper; the artist with this transparent copy can make any number of objects similar in attitude, in size, and in detail, and all can procure fac-similes of patterns, of prints, of autographs, and every other object of artistical decoration and interest, by merely laying the tracing paper above the subject to be copied, and drawing with a pencil whatever is seen beneath.

It is sometimes requisite to transfer a delineation from transparent paper on to another and less flimsy material, for example, an elaborate architectural plan when first formed, must of necessity have upon it numerous false lines, marks of the points of the dividers, &c., which, in the finished plan, would be unsightly; to remedy this it is drawn first on common paper, and then transferred to a thicker and cleaner sheet. This process involves the use of the opaque tracing papers; these are of such a nature that when the prepared side is placed downwards, and any thing is written with a point upon the back, a part of the composition comes off, and leaves a black mark on a piece of paper placed beneath, exactly similar to what may have been written above. Upon this principle the *manifold writers* are made; first is laid a sheet of common paper, upon this a sheet of prepared paper, face downwards, then another piece of common paper, then prepared paper again. This may be repeated three or four times, if the papers be thin, and upon drawing or writing any thing upon the upper sheet, you will have several exactly-similar copies below. Plans and patterns are often drawn in this manner.

Black Lead Paper.—Nothing more is necessary than to paint over, with a brush, a sheet of thin writing paper, with black lead powder, mixed with water. When dry it will be fit for use. It gives lines sufficiently distinct for most puposes, and has the advantage that it may be rubbed out afterwards with Indian rubber when desirable.

Soap Paper.—Rub over one side of a piece of thin paper (using a piece of rag) a mixture of soap, lamp black, and a little water; when dry, wipe off as much as possible with a cloth, to prevent the paper staining the sheet to be placed beneath. It will be quite black, and the marks made by it cannot be obliterated by Indian rubber.

Chalk Paper.—Rub over a piece of paper with a lump of red chalk, and afterwards with a cloth to incorporate the chalk with the grain of the paper, it will be immediately ready for use.

For Manifold Writers.—Is made as recommended for soap paper, but with a little size added.

Outlines for large and not very delicate objects, such as those for embroidery, braiding, paper hanging, when painted by hand, buhl work, ornamental japanning, &c., are often made by a process still simpler than the above; the transparent or other paper upon which the design has been drawn is pricked through, all along the outline, and being laid upon the work beneath, pounded chalk, starch, or red ochre is dusted upon it; the color passing through the holes, is seen beneath in lines, perishable 'tis true, but sufficiently lasting for a pencil, chalk, &c., to be marked over them. If done with powdered rosin instead of the above, the lines given by it may be fixed by heat, this however would, of course, be injurious to delicate fabrics, such as the greater part of those to be embroidered.

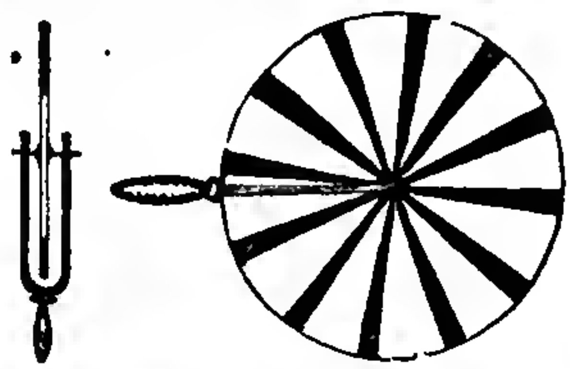
Note.—The French make a thick tracing paper far superior to any we have. It may be bought at

an artist's colorman's, in Oxford Street, and is called *glass paper*. It is made by boiling ivory shavings until they are dissolved, making of them quite a thick jelly, and then adding spirits of wine, pouring this in a thin stratum on a slightly greased surface, such as a marble slap, it is left to harden, and being dried and pressed flat form the substance so erroneously called paper. It is of the texture and appearance of the transparent wafers, and which may be made in the same manner, or isinglass may be used for both.

RAPIDITY OF LIGHTNING.

The incalculable rapidity with which the electric fluid passes from one place to another, not only as seen in our comparatively trivial apparatus, but so much more forceably in the wilder phenomena of lightning, is so evident as to have become of general notoriety, and a powerful simile. Shocks have been passed through wires many miles in extent without any appreciable time being taken up by its passage. Regiments of soldiers have been electrified at the same moment. The fluid has even been passed instantaneously through very long channels of water, although water conducts it with 400 millions of times less rapidity than iron, and this metal twenty times slower than copper. Mrs. Somerville in her far-famed work, "The Connexion of the Physical Sciences," records as follows, the experiments of Professor Wheatstone, to ascertain, if possible, the velocity of the electric fluid in its passage from one body to another.

"The velocity of electricity is so great, that the most rapid motion which can be produced by art appears to be actual rest when compared with it. A wheel revolving with celerity sufficient to render its spokes invisible, when illuminated by a flash of lightning, is seen for an instant with all its spokes distinct, as if it were in a state of absolute repose; because, however rapid the rotation may be, the light has come and already ceased before the wheel has had time to turn through a sensible space."



[The above engraving represents a front and side view of a card-board wheel similar to that alluded to: and the experiment may be performed by taking a spark from the conductor of an electrical machine, or discharging a charged Leyden jar in front of it when revolving rapidly.]

"This beautiful experiment is due to Professor Wheatstone, as well as the following variation of it, which is not less striking.—Since a sun-beam consists of a mixture of blue, yellow, and red light, if a circular piece of pasteboard be divided into three sectors, one of which is painted blue, another yellow, and the third red, it will appear to be white when revolving quickly, because of the rapidity with which the impressions of the colors succeed each other on the retina. But the instant it is illuminated by an electric spark, it seems to stand still, and each color is as distinct as if it were at rest. This transcendent speed of the electric fluid has been ingeniously measured by Professor Wheatstone; and although his experiments are not far enough advanced to enable him to state its absolute celerity, he has ascertained that it much surpasses the velocity of light.

"An insulated copper wire, half a mile long, is so disposed, that its centre and two extremities terminate in the horizontal diameter of a small disc, or circular plate of metal, fixed on the wall of a darkened room. When an electric spark is sent through the wire, it is seen at the three points apparently at the same instant. At the distance of about ten feet, a small revolving mirror is placed, so as to reflect these three sparks during its revolution. From the extreme velocity of the electricity, it is clear, that if the three sparks be simultaneous, they will be reflected, and will vanish before the mirror has sensibly changed its position, however rapid its rotation may be, and they will be seen in a straight line. But if the three sparks be not simultaneously transmitted to the disc—if one, for example, be later than the other two—the mirror will have time to revolve through an indefinitely small arc in the interval between the reflection of the two sparks and the single one. However, the only indication of this small motion of the mirror will be, that the single spark will not be reflected in the same straight line with the other two, but a little above or below it, for the reflection of all three will still be apparently simultaneous, the time intervening being much too short to be appreciated.

"Since the distance of the revolving mirror from the disc, and the number of revolutions which it makes in a second, are known, the deviation of the reflection of the single spark from the reflection of the other two can be computed, and consequently the time elapsed between their consecutive reflections can be ascertained. And as the length of that part of the wire through which the electricity has passed is given, its velocity may be found.

"Since the number of pulses in a second, requisite to produce a musical note of any pitch is known, the number of revolutions accomplished by the mirror in a given time is determined from the musical note produced by a tooth or peg in its axis of rotation striking against a card, or from the notes of a siren attached to the axis. It was thus that Professor Wheatstone found the velocity of the mirror to be such, that an angular deviation of 25° in the appearance of the two sparks would indicate an interval not exceeding the millionth of a second. The use of sound as a measure of velocity is a happy illustration of the connexion of the physical sciences."

THE BAROMETER.

A consideration of the thermometer in the last number leads me to notice its sister instrument, the barometer. As the former is intended to measure intensities of temperature, so the latter is to indicate variations in atmospheric pressure. We are indebted to Torricelli for the invention of this instrument; but there is little doubt that he received the idea of it from his master, the immortal Galileo. Though the atmosphere appears so attenuated a body, and is apparently so light, a little reflection is sufficient to convince us that a vast body of fluid, pressing in all directions upon the surface of the earth, must be of an appreciable weight and

so appreciable is it, that, at the level of the sea, the atmosphere is equal to the weight of fifteen pounds on every square inch. It may be asked, how is man—how are a thousand other things able to sustain this vast pressure? The secret is, that it is exerted equally on all sides, and as it exists in every cavity of the body, the outward pressure is neutralized by the inward. The common sucker, the pump, and the cupping glass, are familiar instances of this pressure exercised in different ways, though all arising from the same cause; but let us not digress from the subject immediately under consideration.

It is a law of hydrostatics, that, when different fluids of different specific gravities are made to balance each other in communicating vessels, their surfaces will not be at the same height, but that of the lighter will be so much above the denser as they differ in gravity; thus it requires a long column of water to balance a short column of mercury; and, again, if a column of air be substituted for the water, a much larger one will be required. In this experiment the diameters of the vessels will have no effect upon the level assumed by the balanced fluids, and I need not say that air is as much a fluid as water or mercury. It is found, that, at the level of the sea, the superincumbent atmosphere is sufficient to support a column of water thirty-four feet in height, or one of mercury measuring thirty inches; as we ascend, however, the pressure becomes less, so a shorter column only can be sustained, and on this fact the whole theory of the barometer depends.

This instrument may be easily constructed by any one who can command an air-pump; a bent tube must be selected, both the legs of which should be nearly forty inches long, one open and the other hermetically sealed. This tube must be completely exhausted of air, and mercury then be poured in at the open end, by which means the opposite leg is entirely filled with the fluid metal; if the tube be now set upright, we find that the mercury will fall to a certain extent, and stand at about thirty inches above the surface of the level of the metal in the opposite tube, while the latter tube being left open, the mercury is exposed to every variation of pressure, and the top of the mercurial tube being vacuous,* no resistance is offered to the rise or fall of the metal. The chief precautions to be attended to are, that the tubes be of sufficient calibre to avoid the effects of capillary attraction and also that the mercury be pure and free from air-bubbles; on which account it is advisable to filter it by pressure through chamois leather. One of the most familiar applications of the barometer is as a weather glass, and when it is to be used for this purpose a float is placed on the surface of the mercury, which float, balanced by another weight, works upon a pulley, the axis of which, being furnished with a hand like a clock, denotes by its movements upon a scale the density or rarefaction of the atmosphere; thus, for example, in bad weather, the atmosphere being unusually dense, the mercury is depressed, and carries with it the float, which influencing the pointer, denotes the weather as *stormy*. The average height of the barometer in England is 29·8, and its range seldom exceeds three or four inches, therefore the uncovered portion is about six inches, for instance from 27 to 32; a falling barometer presaging wind and rain—a rising one the reverse. The causes which produce these phenomena are not sufficiently understood to enable us to deduce any very certain laws from them; however, as a general rule, the indications of the weather glass may be depended upon; and as meteorological observations become more general, so will the barometer become more valuable.

* This space, which should be perfectly exhausted, is generally designated "The Torricellian Vacuum;" and that produced by the air pump is called "The Boylean Vacuum."

Another important application of this instrument is in measuring heights, and the reason of this is very evident when we reflect, that, if forty miles of air weigh fifteen pounds per square inch, thirty-nine miles must weigh less; thus, on the summit of a high mountain, this pressure of the atmosphere would be very much diminished—while, on the other hand in a deep mine it would be increased; on the top of Mount Blanc, 15,000 feet above the level of the sea, the barometer stands at fifteen inches; here one-half of the whole pressure is removed. This, however, is only an evidence of the increasing expansibility of air, as it is subjected to less pressure, and this expansion goes on at a rapidly-increasing rate from the earth to the upper surface of the air. It was this circumstance that led Marriott to the supposition that matter was indefinitely divisible; this, however, has been proved incorrect by modern philosophers, and confirmed by astronomy; and it is now admitted that the ultimate atoms of the atmosphere come at length to balance each other, and find their true level like any other fluid,—a beautiful confirmation of the atomic theory.

From what I have said it will be perceived on what principle the barometer is used to measure alevations; and it were unnecessary to say how important a part it plays in the graduation of thermometers.

W. PRESTON.

MORASSES.

When woods have repeatedly grown and perished, morasses are in process of time produced, and their long roots fill up the interstices till the whole becomes for many yards deep a mass of vegetation. This fact is curiously verified by an account given many years ago by the Earl of Cromartie, of which the following is a short abstract:

In the year 1651 the Earl of Cromartie, being then nineteen years of age, saw a plain in the parish of Lockburn covered over with a firm standing wood, which was so old that not only the trees had no green leaves upon them, but the bark was totally thrown off, which he was there informed by the old countrymen was the universal manner in which fir-woods terminated, and that in twenty or thirty years the trees would cast themselves up by the roots. About fifteen years after he had occasion to travel the same way, and observed that there was not a tree nor the appearance of a root of any of them; but in their place the whole plain where the wood stood was covered with a flat green moss or morass, and on asking the country people what was become of the wood, he was informed that no one had been at the trouble to carry it away, but that it had been all overturned by the wind, that the trees lay thick over each other, and that the moss or bog had overgrown the whole timber, which they added was occasioned by the moisture which came down from the high hills above it and stagnated upon the plain, and that nobody could yet pass over it, which however his lordship was so incautious as to attempt and slipped up to the arm-pits. Before the year 1699 that whole piece of ground was become a solid

moss wherein the peasants then dug turf or peat, which however was not yet of the heat sort.—*Philos. Trans. Abrid., Vol. V., p. 272.*

Morasses in great length of time undergo variety of changes, first by elutriation, and afterwards by fermentation, and the heat consequently produced. By water perpetually oozing through them the most soluble parts are first washed away, as the essential salts, these together with the salts from animal recrements are carried down the rivers into the sea, where all of them seem to decompose each other except the marine salt. Hence the ashes of peat contain little or no vegetable alkali, and are not used in the countries where peat constitutes the fuel of the lower people, for the purpose of washing linen. The second thing which is always seen oozing from the morasses is iron in solution, which produces chalybeate spring, from whence depositions of ochre and variety of iron ores. The third elutriation seems to consist of vegetable acid, which by means unknown appears to be converted into various other acids. 1. Into marine and nitrous acids as mentioned above. 2. Into vitriolic acid which is found in some morasses so plentifully as to preserve the bodies of animals from putrefaction which have been buried in them, and this acid carried away by rain and dews, and meeting with calcareous earth, produces gypsum or alabaster; with clay it produces alum, and deprived of its oxygen produces sulphur. 3. Fluoric acid, which being washed away and meeting with calcareous earth produces fluor or cubic spar. 4. The siliceous acid which seems to have been disseminated in great quantity either by solution in water or by solution in air, and appears to have produced the sand in the sea uniting with calcareous earth previously dissolved in that element, from which were afterwards formed some of the grit-stone rocks by means of a siliceous or calcareous cement. By its union with the calcareous earth of the morass other strata of siliceous sand have been produced; and by the mixture of this with clay and lime arose the bed of marl.

In other circumstances, probably where less moisture has prevailed, morasses seem to have undergone a fermentation, as other vegetable matter, new hay for instance, is liable to do from the great quantity of sugar it contains. From the great heat thus produced in the lower parts of immense beds of morass, oil, or asphaltum becomes distilled, and rising into higher strata becomes again condensed, forming coal beds of greater or less purity according to their greater or less quantity of inflammable matter; at the same time the clay beds become purer or less so, as the bitumen is more or less exhaled from them. Though coal and clay are frequently produced in this manner, yet they are likewise often produced by elutriation; in situations on declivities the clay is washed away down into the valleys, and the phlogistic part or coal left behind; this circumstance is seen in many valleys near the beds of rivers, which are covered recently by a whitish impure clay, called water-clay.

Lord Cromartie has furnished another curious observation on morasses in the paper above refered to. In a moss near the town of Elgin in Murray, though there is no river or water which communicates with the moss, yet for three or four feet of depth in the moss there are little shell-fish resembling oysters, with living fish in them in great quantities, though no such fish are found in the adjacent rivers, nor even in the water pits in the moss, but only in the solid substance of the moss. This curious fact not only accounts for the shells sometimes found on the surface of the coals, and in the clay above them but also for a thin stratum of shells which sometimes exists over iron ore.

MISCELLANIES.

Fumigating Pastiles are employed for removing close and unpleasant smells from apartments; the receipts for them are as numerous as the scents required. The following are the most esteemed:—

Musk Pastiles.—

Gum Arabic	2 ounces
Charcoal powder	5 ,,
Cascarilla bark (pounded) .	½ ,,
Saltpetre	¼ ,,

Mix together with water, and make into shape.

Pastiles a la rose.—

Gum Arabic	1 ounce.
Gum olibanum	1 ,,
Storax	1 ,,
Nitre.	¾ ,,
Charcoal powder	6 ,,
Oil of roses	20 drops.

The above mixture is to be thickened with a quarter of an ounce of gum tragacanth, dissolved in rose water, and the whole pounded and made into a paste.

Pastiles forming the Incense used in Religious Ceremonies:—

Ambergris	8 drams.
Powder of rose leaves . .	4 ,,
Gum benzoin	2 ounces.
Essence of roses	1 ,,
Gum tragacanth	1 ,,

And a few drops of the oil of red sanders wood.

The following receipts are also recommended.—

1.—Gum benzoin, olibanum, frankincense and mastic, of each 1 ounce, charcoal 1½ lb., gum tragacanth 4 drams, water sufficient to make the mixture when pounded into a paste.

2.—Benzoin 3 drams, mastic olibanum, of each ½ a dram, Cascarilla bark, oil of cloves, balsam of Peru, of each one dram, charcoal 2½ ounces, oil of lavender 10 drops, camphor 2 scruples, gum tragacanth 4 drams, water as before.

3.—Benzoin 8 ounces, styrax 1½ ounce, labdanum, olibanum, mastic and cloves 1½ dram of each, charcoal, 2 lbs. 4oz., mucilage of gum tragacanth as much as is sufficient to make it into a paste.

4.—Powder of sandal wood 1 ounce, powder of cascarilla bark 1 ounce, powder of cloves 1 ounce olibanum 4 drams, gum benzoin 4 drams, powdered charcoal 4 drams, camphor 2 drams, essence of lemon 20 drops, essence of bergamotte 20 drops, oil of lavender 15 drops, frankincense 1 oz.

5.—Benzoin 1 pound, storax ½lb., cinnamon ½oz., cloves ½oz., rose leaves 2 ounces, calamus aromaticus a stick, beat up with mucilage of gum tragacanth made with rose and orange flower water.

6.—Gum benzoin 1 pound, cloves ¼ oz. cinnamon 2 drams, gumwater to make it into a paste.

7.—Styrax and benzoin of each 4 ounces, sandal wood and labdanum each 1 ounce, charcoal 24 ounces with gumwater as before.

Improved Cement for holding Small Lenses, while Grinding and Polishing them.—In grinding small lenses, Mr. Pritchard found that shell-lac, the cement usually employed for them, was by no means sufficiently strong to retain them. He was fortunate enough, however, to attain his object by adding to the shell-lac an equal weight of finely levigated

pumice, carefully melting them together in an iron vessel, and stirring them till well incorporated. Great care is required in using it, not to beat it hotter than is absolutely required in melting it, and io fixiog the lens securely, otherwise it becomes unfit for use; and the same caution is equally required io using shell-lac alone.

Artificial Garnets.—Tako two ounces of pure white glass, one ounce of glass of antimony, one grain of the powder of cassius, and one grain of manganese; reduce the materials to powder, mix them intimately, aod then fuse them in a crucible. The prodoct will be a gem so like the real garnet, that no common observer will discover the difference.

New Light.—Tha well known combination of turpeotine and alcohol for the production of light, has at length heen applied to domestic and permanent use. A patent bas been taken out in New York for a lamp which, by the aid of a wick of fibrous asbestus, of wire, or *of cotton* gives out o flame, clear, dense, and brilliant, withoot smoke, or smell, or grease, or dripping from the lamp, without snuffing, and as cheap as that from spermaceti oil.

The use of the Microscope.—When Swammerdam died, and no one found himself equal to succeed him a report was raised that his microscopic was of a peculiar kind, and the mode of using it was thus lost at his death; so it is at present wtth Bauer. Many applications are made to the mathematical instrument makers for a Bauer's microscope, by those who are not willing to believe it is their own inability and not the fault of the microscope, tlat prevents their arriving at his excellence in observatioo.

Ventilation.—The following simple method of ventilating large halls, theatres, &c., bas been found hy M. Van Marûm to answer most effectually:—Let a common Argand lamp he suspended from the roof, aod kept burning under a funnel, the tube of which is carried out into the open air, and furnished with a veotilator. In one experiment made with this apparatus, M. Van Marûm first filled his laboratory with smoke of deal shavings, and then lighted the lamp; in a few minutes after, the whole smoke had disappeared, and the air was completely purified.

To dissolve Copol, as commonly dona by means of alcobol, it is a very tedious process; but if a little camphor is previously dissolved in tha alcohol, the solntion may be effected in half the time.

To the Editor.

SIR—Reading in one of your numbers the subject of Cleaning Shells, I beg to inform yoo that being with a celebrated conchologist some years ago, I was in the habit of seeing and practising most of the processes you mention, hut the use of Florence oil is quite novel to me; a better, and in my opioion what gives the shell a still more natural appearance, is the application of albumen or white of egg, laid on with a small camel's hair brush. This is what I have used myself, and when dry, it gives the shell a much more natural appearance than oiling it. Your's, &c. R. S. T.

ANSWERS TO QUERIES.

30—*How is canvas prepared for oil pointers?* It is first strained tightly npoo frames—then washed with a thin glue. When dry It is painted with a coat of oil color, made of white lead, red lead, linseed oil, and turpentioe; and afterwards with a second coat, in wbicb tha red lead is omitted, and sugar of lead, with a little coloring matter, substituted.

31—*How are the leads for ever-pointed pencils made?* Fioely powdered best black lead is mixed with hot glue to the consistence of a thick paste, in which state, and before it is cold, the composition is passed through a funnel-shaped mould. Being pressed out at the small end it assumes the proper form, and its degree of hardness is proportionate to the relativa quantity of glua employed.

70—*How may tin plates be variegated and colored?* Answered in page 111.

73—*How is the varnish for patent leather made?* By mixing together equal parts of tar varnish and Pontepoole varnisb. The leather must have two coats, and be dried io n hot place.

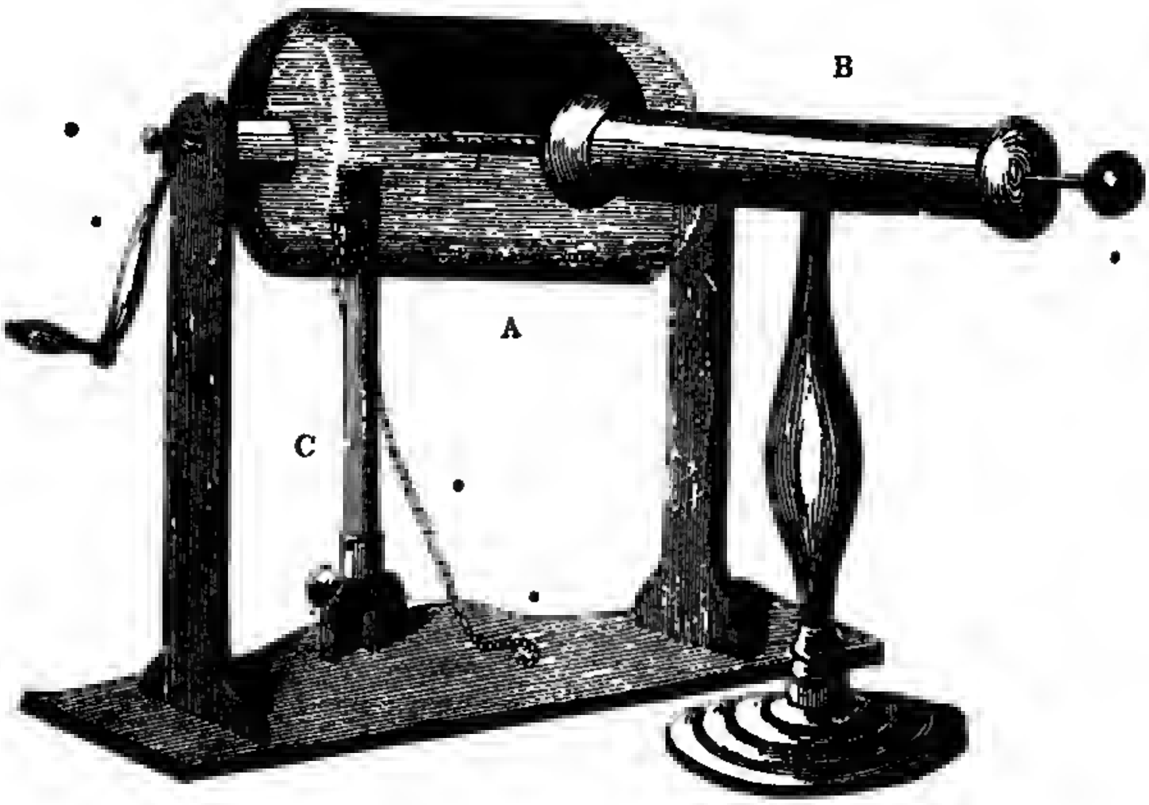
83—*Is there ony method of preserving polished steel from rust?* The following metbod has been communicated by M. Paymen to the Institute of France:—It consists in plunging the pieces to be preserved ioto a mixture of one part concentrated solution of impure soda (soda of commerce,) and three parts of water. Pieces of iron left for three weeks in this liquid neitber lost weight or polish, while similar pieces in five days, in simple water, were covered with rust. - MORNING CHRONICLE, Jone 27th.

88.—*How ore those brilliont colors obtoined which we see in chemists' windows?* Red—Boil a few grains of cochineal in water. Purple—To the red liquor add a little Prussian blue. Yellow—Boil in water either quercitron bark, or turmeric. Straw Color—Gamboge dissolved in water. Green—Dissolve verdigris in water, to which add a little vinegar. Pink—Boil safflower in water, or what is the sama thing, dissolve the color off a pink saucer. Blue—make a solution of sulphate of copper, (blue stone,) and add to it spirits of hartshorn until the color is obtained.

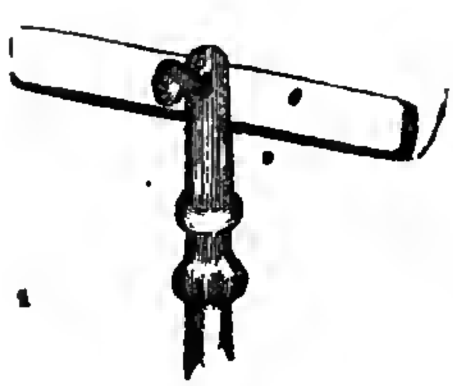
93—*How may o good vornish be made for balloons?* India rubber varnish, made hy dissolving India rubber in the naphtha of coal tar, is now employed. The following appears in an old print:—Take one pound of bird lime, put it into a new eartheo pot that will resist the fire, and let it boil gently for about one hour: viz. till it ceases to crackle; then poor upon it a pound of spirits of turpentine; stirring it at the same time with a wooden spatula, and keeping the pot from any flame, lest the vapour should toke fire. After this let it boil for about six minntes longer; then pour npon the wbole three pounds of boiling linseed oil, rendered drying by means of litharge—stir it well, let it boil for a quarter of an bour longer, and the varnish Is made. After it has rested for twenty-four hours, and tha sedimeot has gone to the bottom, decant it into another pot, and, wheo you want to use it, warm and apply it with a flat brush. C. E. S.

95—*Is the atmosphere ever in such a state that the smoke cannot ascend?* Yes frequently—Smoka is nothing more than the particles of soot carried npwards by heated air—when the air accompanying it becomes cooled, the soot falls of necessity. So also if the atmosphere he misty or rainy, and therefore not buoyant, the sooty particles will fall downwards directly, just the same as a fog arises from the falling of the vapours above.

Fig. 1.



CYLINDER ELECTRICAL MACHINE.



2.

ELECTRICITY.

(Resumed from page 107.)

As soon as the different nature of electrics and conductors had been ascertained, and it was known that electrical effects were in proportion to the friction which produced them, philosophers endeavoured to construct machines for the greater accumulation of the electric fluid. To Otto Guericke, the inventor of the air-pump, we are indebted for the first of these; it was a globe of sulphur, turned rapidly on an axis by means of a wheel and treadle, the friction was produced by holding the hand against the globes. L'Abbe Nollet added a *conductor*, this was a brass rod suspended by silk from the ceiling. Dr. Watson suspended three globes in a similar manner and added a *cushion* to each; this latter was a very great improvement; the conductor was suspended from the ceiling as before. Mr. Wilson used a glass globe instead of one of sulphur; added much to the portability of the machine, by suspending the conductor on silk lines stretched across two pair of glass rods, placed on the stand of the machine itself. Now also a screw was first used to modify the pressure of the cushion, and points attached to the conductor. For the next great improvement in this apparatus we are indebted to Mr. Nairne, who employed a cylinder of glass, which he supported vertically; he attached a spring to the cushion, used amalgam upon it. and supported the conductor upon a single glass pillar; thus in his hands that which was before cumbrous and comparatively ineffective, became a useful, a portable, and easily-constructed instrument, rendered, however, yet more convenient and powerful by the horizontal position of the cylinder, and the silk flap soon afterwards suggested by Dr. Priestly. This was the history of the cylinder machine, and the following is its usual and simplest construction:—

A, Figure 1, is a glass cylinder having upon each end of it a cap of wood or brass, and supported by a stand with two uprights. The end of one cap is turned with a pivot, which fits into a hole near the top of one of the uprights. The other cap is turned with a similar pivot, and has beyond this a flanch and a square gudgeon, upon which a handle fits. This end of the cylinder is supported in a similar manner to the other end, but instead of a hole merely being bored in the upright leg, a portion is cut away, that the cylinder may be the more easily taken out and put up again in its place; it may be secured when there by a pin run through the upright just above the axis of the cap. Behind the cylinder is a *cushion* which extends in length to within an inch of either end of the cylinder, it is from one to two inches in width, according to the size of the cylinder, and made in the same manner as those alluded to in page 106. On the lower part of the cushion is glued a flap of leather (the rough side outwards), and on the edge of the leather the silk flap which passes over the cylinder when in action. The cushion is supported sometimes by a thick rod of glass with a wooden spring at the top of it as in the figure; at other times a springy piece of wood alone is used. It is fastened at the top to the cushion by a hand-screw, which passes through the support, and is fixed by a thread in the back of the cushion itself. The lower end of the support for the cushion is made so as to slide backwards and forwards, either on the top, or still better underneath the stand, and is held in its position by a thumb-screw.

B represents the *prime conductor*, formed either of wood covered neatly with tin foil, or of metal. It has round and smooth ends, at one of them a ball and wire for the suspending of various apparatus, at the other a projecting wire furnished with a row of points to collect the fluid when disturbed by the cylinder. It is necessarily supported upon a glass pillar, sometimes attached at the lower end to the same stand as the rest of the machine, in which case the conductor runs parallel to the cylinder, and has the points driven into the side instead of the end. At other times it is fixed to a separate foot, as is to be seen in the figure No. 1. At the top of the conductor are two or three holes to afford greater facility in performing experiments.

Figure 2, shows the attachment of the cushion to the spring, and glass leg which supports it.

To make a Machine.—In making a cylinder machine, observe carefully the following directions.

The centre of the cylinder; of the cushion; and of the conductor should be of the same height The lower part of the cylinder, unless in a very small machine, should be at least 10 inches above the foot of the stand beneath. The glass pillar of the prime conductor not less then 14 inches long, the conductor itself about as long as the cylinder, and from 2 to 3 inches diameter; the points projecting nearly an inch. The silk flap should be thin and extend to within an inch of the points. Fix the caps upon the cylinder thus:—Make some cement according to the following receipt which have melted ready for use: roughen with a file the glass on each end of the cylinder, and bore a small hole through the axis of that cap which does *not* bear the handle; this done, stop up the inner end of the hole again with a small piece of dough, putty, or clay. Now grease the outside of this cap well, put it in an upright position, half-fill it with the melted cement, warm well the end of the cylinder, put it upright into the prepared cap, let it remain till the cement is hard and then clear out the hole through the centre by a hot wire; being very careful that it is at all times afterwards left open. This is necessary as a vent for the heated air, which of course will be liable otherwise to burst the cylinder, not merely when the other cap is fixed to it, but ever afterwards when the machine is in action. The hole being thus opened, the other cap may be fixed on in the same manner; a second hole however is not necessary. The cause of greasing the outside of the cap is, that any cement which flows over may not stick to it.

By attending to the above description and observations, an electrical machine may be made out of a common sample phial, capable of giving sparks, charging a Leyden jar, and performing most of the simple electrical experiments.

Electrical Cement.—Put together in a pipkin over the fire, 2 lbs. of yellow rosin, 4 ounces of bees' wax, and a quarter of a pint of linseed oil; to which add when melted about half a pound of red ochre; stir them together and they will be fit for use when wanted; the cement must never be heated so much as to be frothy.

To work the Machine.—Warm the whole well before the fire, and cleanse it from all damp and dust. Take off the cushion, scrape away all dirt, spread evenly upon it some fresh amalgam (a receipt for which see page 44), put it back in its proper place, and fasten to the screw which connects it with its upright a brass chain, the other end of which reaches to the table or floor, or the walls of the apartment. Upon now turning the handle, streams

of fluid will be seen to issue from the cushion, and passing under the silk, to fly off at its edges. To collect the fluid, place the conductor with its points about a quarter of an inch from the edge of the silk, which will so readily attract the fluid from the cylinder, that sparks proportionate to the extent of the glass surface rubbed may be taken from it, being very careful however that the glass stand of the conductor be perfectly dry. The pressure of the cushion against the cylinder is to be regulated by the screw on the stand at bottom.

Note.—If the machine be small, it will require frequent warming; the power of a machine is generally increased by rubbing the cylinder for a minute or two with a slightly greased rag, or by putting one hand upon the cushion.

The rationale of the action going on, is this:—the fluid passes from the earth through means of the floor, walls &c., to the chain suspended from the cushion, here friction, which is the cause of the disturbance, takes place. The disturbed fluid passes to the glass cylinder, and is confined from escape by the silk flap; that ceasing, the fluid would fly to any thing around, particularly to a pointed body, or a lighted candle, but this is prevented by the superior attraction for it from the nearer end of the prime conductor put to receive it. Thus it will be at once seen that an electrical machine resembles a pump; the earth may be likened to a well of water; the chain to the lower pipe of a pump; the cushion is the sucker; the silk the nozzle, and the prime conductor is like a pail to hold the fluid.

INSECTS.

(Resumed from page 120.)

SETTING AND PRESERVING.

Collectors are generally satisfied if they can obtain the insect in its last, or fly state; but as a few instructions for the preservation of the egg, caterpillar and chrysalis, may induce some future naturalist to enrich their cabinets with such specimens, in addition to the insect itself, we have selected a few particulars for their purpose.

The eggs of most insects retain their form and color well, if preserved in the cabinet; but those which do not promise fairly may be prepared after the method practised by Swammerdam. He used to pierce the eggs with a very fine needle, and press all the contained juices through the aperture; then inflated them until they regained their proper form by means of a small glass tube, and lastly filled them with oil of spike, in which some resin had been dissolved.

The Caterpillar.—The preservation of insects in this state is not only one of the most curious, but useful discoveries that have been made in this department of science. They may be preserved by being plunged in phials filled with well rectified spirits of wine. This method should ever be prefered by those who collect in a distant country, if their subjects are not likely to be injured by such a process; the most delicate caterpillars will retain their exact size, but the spirits will generally extract the color, and from those especially which have very tender skins.

But the manner in which Swammerdam preserved his caterpillars, completely obviates this defect, and if carefully managed, it not only preserves the exact size, but generally retains the colors as perfectly as in the living creature.

He used to make a small incision or puncture in the tail, and having very gently, and with much patience, pressed out all the contained humours, injected wax in them: so as to give them all the appearance of healthy living insects. In this manner he has preserved many very small specimens. There is another method which is more generally known to collectors. It consists in taking out all the inside of the caterpillar, and inflating the skin by means of a glass tube.

The entrails, with whatever of the fleshy substance can conveniently, is drawn through the anus by means of fine wire, curved at the end; when the inside is emptied, the glass tube is inserted into the opening, through which the operator continues to blow, while he turns the skin round slowly at the end over a charcoal fire; this hardens the skin equally, and dries up all the moisture within. A pin is then put through it to fix it in a standing position; if the skin is tender it may be filled with white paper or cotton.

But this is a most cruel operation on the little victim, and such as must shock the feelings of the humane soul. If, therefore, any other method can be introduced, which will effect the purpose in a short time, the practice should be exploded as wanton barbarity.

Various attempts have been made, and among these some have tried to drown the caterpillar; but you will never be able to accomplish his death in this manner, unless it remains for a considerable time under water, and though it may appear dead, the principle of life will not be destroyed. Mr. Bonnet, making experiments on the respiration of insects, had one caterpillar which lived eight days, with only two of its anterior spiracula in the air.

The method we wish to recommend is to observe when the caterpillar is on the point of casting its last skin—drop it by the threads into scalding water, and quickly withdraw it; the creature will be killed instantly; then put it into some distilled vinegar mixed with spirits of wine, which will give a proper firmness to all the parts, and accelerate the separation of the skin from the body; the flesh may be carefully extracted, and the exuvia or skin be blown up by means of a glass tube while suspended over a charcoal fire, as before described.

Anoint it with oil of spike in which some resin has been dissolved, unless it is a hairy caterpillar.

The Pupa or Chrysalis.—When insects have quitted the pupa state, the case will require only to be put into the drawer or boxes with some camphor, but those which haves the insects within, must be either dropped into scalding water, or inclosed in a small chip box, and exposed to the heat of a fire, which will shortly kill the insect within.

It will be found, that if those chrysalides which have the appearance of gold, are put into spirits of wine they will always retain that color; but if the insect within is killed first, or if the fly has quitted it, such appearance is entirely lost.

Coleopterous Insects, or Beetles.—The preservation of this order of insects is attended with very little difficulty.

If you drop them into scalding water they die in an instant, but the moisture they imbibe can never be sufficiently exhaled to prevent mouldiness, after they have been a short time in the cabinet.

The best method is to inclose them in a small chip box, and kill them by exposing the box to the heat of a fire; this treatment will rather absorb than add to the superfluous juices of the insect, and greatly contribute to its preservation.

Those of the *Meloe* genus have soft tender bodies which shrivel after death; to preserve those, make

an incision at the extremity of the abdomen, probe out the entrails, and fill the cavity with fine tow.

Several foreign species of cassida, and many other *Coleopterous* insects, are beautifully variegated with a golden color that dies with the creature; if you plunge them into well rectified spirits of wine, when alive, they soon expire and retain their golden appearance; but if taken out and dried, that brilliance will be irretrievably lost.

Tha Chinese seldom take care to display the parts of their insects after the European manner—those we receive from China are stuck on long needles; if beetles, often through one elytra, so that the membranaceous wings are entirely concealed.

If the insects require only a little relaxation to extend the parts, use a camel's-hair pencil, moistened with spirits of wine; but if this should prove insufficient, fix them on a piece of cork, and float them in an earthen pan, half filled with water; it is better to cover the pan with a damp cloth, and the insects will be so limber, after a few hours, that they may be re-set in any position.

Large beetles are usually stuck through one of the shells; but smaller insects are better if displayed on a small piece of card, being fixed with strong gum, or they may be pierced through the head, see fig. C and D.

C A B D

Insects of the *Hemiptera* order, as *cimices*, &c., may be treated in the same manner.

It is usual to put two specimens of each species of the butterfly kind into the cabinet, one to display the upper, and the other the under side; for the under side is much more beautiful in most species, and differs entirely in appearance from the upper side.

Sphinxes and moths are generally disposed in pairs to show the male and female, and as their under sides are seldom very beautiful, only their upper sides are shown.

Except a few species, moths constantly conceal their under wings when at rest; but collectors sacrifice the propriety of their remaining in a natural position, in order to display the under wings. It is advisable to have one of every kind in a natural posture, as that will often essentially assist to determine the family of the insect.

Provide a quantity of card braces, made in the same form as that represented in the following figure A, and a board of a convenient size, covered with soft cork; it must be perfectly even on the surface, and papered; this is termed the setting board. For small moths it is only necessary to put the pin through the thorax, and they die in a very short time: but for larger kinds the pin should be dipped in strong aquafortis before it is put through the insect.

It is very difficult to kill the largest kinds of moths and sphinxes. Select a large pin (comparatively for the size of the insect) and dip it into aquafortis as before, but immediately that the pin is forced through the thorax withdraw it, and put a drop of aquafortis into the wound; should this prove insufficient to kill it, put the point of the pin through a card, and hold it in the flame of a candle until it becomes red hot; this will kill the insect immediately, and the card will protect it from being injured by the flame.

The moth is then to be fixed on the setting board, and the braces are to be applied in the manner shown in the fig. B. The wings are to be carefully displayed by means of a large pin, and the braces put close down to prevent the return to the natural position. All insects must be set while they remain limber for if the parts stiffen they are apt to snap—they may be relaxed by floating them in a pan of water.

Insects should remain beneath the braces on the setting board until all the aqueous moisture be evaporated, or the wings will start from their position, and the bodies turn black, or mouldy; they should be placed in a dry situation, and be covered with gauze, for the admission of air, for the space of a month at least before they are put into the cabinet.

It is proper in this place to caution the young beginner not to attempt to kill the insects by fumigations of sulphur, &c., a practice too frequent with persons of this description, for should he by this means deprive the creature of its life, he will also deprive it of its beauty; it is even doubtful whether many may not survive the operation.

M. Lyonet placed several of the large musk beetles, probably the *Cerambyx moschatus*, under a glass where he had been burning sulphur, and which he kept burning while they were there; and though the vapour was so thick that he could not discern them, and that he kept them therein more than half an hour, they did not seem in the least incommoded.

Some moths are very liable to change color when placed in the cabinet, and particularly those which collectors term *full-bodied*. An oily matter is common to all insects, but those are charged with a superabundance. It appears at first in spots on the body, but generally pervades every part; in some it will even descend into the wings, and then an obliteration of all the tender marks and beautiful specklings is the least that may be expected, if a total change of its colors, to an uniform dirty brown, does not ensue. Hence it is that many of the Linnean descriptions of insects appear defective to such as breed them; we not unfrequently read, *body black*, though we know that part of the insect is white in every specimen that is not greasy; the body of the satin moth is perfectly white when fine, but after it has been killed some time it becomes black in parts; the body of the burnet sphinx is of a very brilliant blue color, with yellow bands on every annulation, when alive, but changes to a velvety black soon after the insect dies; the same is observed on the body of the currant sphinx—and every part of the hornet sphinx changes to a jet black, after being some time in the cabinet; although when alive it is a very bright yellow, with a band of purple. Hence also it is that some specimens of very common insects are valuable, by having preserved their proper colors uninjured.

Various methods have been tried to extract the grease from moths, but a preventive should always be preferred. If the grease has not spread into the wings, the insect may sometimes be cured, but it will be very difficult, if not impossible, to eradicate the grease which has settled in patches on the wings.

Large moths are to be opened in a strait line along the under side of the body, the entrails, &c., taken out, and the cavity filled with fine tow or cotton. This should be performed soon after the

insect is dead. The most delicate specimens may be preserved entire by this means; we have some very valuable sphinxes, moths, &c., which were collected by an intelligent person in North America: they retain their colors to the utmost degree of perfection, and have only been prevented changing black by this simple preparation.

The method which is most successful for recovering the original appearance after the insect has become greasy, is to powder some fine dry chalk on a piece of heated iron; cover the chalk with a very fine linen cloth, and thereto apply the under part of the body of the insect: the heat of the iron dissolves the grease, while the chalk absorbs it, and the linen cloth prevents the chalk from clotting to the insect. This process may be repeated several times if the grease is not entirely eradicated by the first attempt. Always observing to exactly attemperete the heat of the iron.

They may be baked in a slack oven with the chalk placed to absorb the grease, without any considerable injury to the colors.

Some collectors open the bodies of large moths, take out the entrails, and fill the cavity with fine dry powdered chalk.

(Continued on page 171.)

OIL ON WATER.

There is reason to believe that when oil is poured upon water, the two surfaces do not touch each other, but that the oil is suspended over the water by their mutual repulsion. This seems to be rendered probable by the following experiment; if one drop of oil be dropped on a basin of water, it will immediately diffuse itself over the whole, for there being no friction between the two surfaces, there is nothing to prevent its spreading itself by the gravity of the upper part of it, except its own tenacity, into a pellicle of the greatest tenuity. But if a second drop of oil be put upon the former, it does not spread itself, but remains in the form of a drop, as the other already occupied the whole surface of the basin, and there is friction in oil passing over oil, though none in oil passing over water.

Hence when oil is diffused on the surface of water gentle breezes have no influence in raising waves upon it; for a small quantity of oil will cover a very great surface of water, and the wind blowing upon this carries it gradually forwards; and there being no friction between the two surfaces the water is not affected. On which account oil has no effect in stilling the agitation of the water after the wind ceases, as was found by the experiments of Dr. Franklin.

This circumstance, brought into notice by Dr. Franklin, had been mentioned by Pliny, and is said to be in use by the divers for pearls, who in windy weather take down with them a little oil in their mouths, which they occasionally give out when the inequality of the supernatant waves prevents them seeing sufficiently distinctly for their purpose.

The wonderful tenuity with which oil can be spread upon water is evinced by a few drops projected from a bridge, where the eye is properly placed over it, passing through all the prismatic colors as it diffuses itself; and also from another curious experiment of Dr. Franklin's. He cut a piece of cork to about the size of a letter wafer, leaving a point standing off like a tangent at one edge of the circle. This piece of cork was then dipped in oil, and thrown into a large pond of water, and as the oil flowed off at the point, the cork-wafer continued to revolve in a contrary direction for several minutes; the oil flowing off all that time at the pointed tangent in colored streams. In a small pond of water this experiment does not so well succeed, as the circulation of the cork stops as soon as the water becomes covered with the pellicle of oil.

MICROSCOPES.

Sir D. Brewster remarks in his treatise on the Microscope in the "Encyclopedia Britannica," that "every department of nature is full of objects, from the examination of which the most important discoveries may be expected; but though the zealous observer can never be at a loss for subjects of research, it is desirable to know what has been done by our predecessors, and what treins of inquiry are most likely to prove of general interest. There are subjects of microscopic investigation which are closely connected with the most interesting parts of philosophy; and even geology itself, conversant with the grandest subjects of research, has recently been illustrated by the aid of the microscope."

With how much force the learned Professor might have applied his observation to entomology, to botany, and to chemistry. The microscope indeed is now become of the utmost necessity to the natural philosopher, and so general in use, that there are but few persons of liberal education who do not, partially at least, understand and practice with this valuable instrument. This being so evidently the case, we cannot doubt but that some practical remarks on microscopes in general, and instructions on the mounting and selecting microscopic objects, will tend to the furtherance of their pursuits in this delightful and interesting investigation. Those who have no microscope may produce one that is both powerful and cheap by either of the following methods:—

To make a Stanhope Lens.—A Stanhope lens consists merely of a piece of glass-rod, about a quarter of a inch thick, and three-eighths long, rounded at both ends. In consequence of this rounding of the ends, it becomes a very thick convex lens, and whatever is put close to one end is seen much magnified when the eye is placed at the other. Thus, if one end is suffered to touch the skin of the face it will be covered with minute drops of moisture, imperceptible to the naked eye, but appearing large and very conspicuous when seen through the lens. The lens is usually fixed to a handle for the convenience of using it. It may be made as follows: Procure a piece of glass tube, of the size above mentioned, and grind the ends of it pretty accurately round on a common grindstone. This done, fasten a solid hard wooden chuck upon the maudril of a lathe, (a brass or iron chuck is better,) and turn in the centre of the face of the chuck a semi-circular hole of proper size, just to admit the end of the tube—put a little fine sand, or emery powder, into this hole—put the lathe in motion, when, upon holding the glass tube steadily against the sand, the end of it will be ground to a true semi-circular surface, which requires afterwards to be polished by another similar chuck with putty powder, instead of sand; and thus, for about a farthing, a perfect and valuable instrument may be obtained.

To make Spherical Lenses.—Procure a piece of thin platinum wire, and twist it once round a pin's point, so as to form a minute ring with a handle

to it. Break up a piece of flint glass into fragments, about the size of the seeds of mustard, or a little larger—place one of these pieces on the ring of wire, and hold it in the point of the flame of a candle, or gas-light, when the glass will melt, and assume a complete lens-like, or globular, form—let it cool gradually, and keep it for mounting: others may be made immediately in the same manner, and if the operation be carefully conducted not one in twenty lenses will be imperfect. It may be remarked, that the smaller the drop the more globular it will remain, and consequently the higher will be the power of its magnifying properties. These lenses are not to be despised because of simple construction—on the contrary, few equal them in discerning power, the most delicate test objects may generally be very clearly discerned with much more distinctness indeed then by the commoner kinds of microscopes, as sold at the opticians. Their magnifying power, too, is very considerable, varying from 30 to 200 times linear measure, or, as these things are popularly understood, they will magnify objects from 900 to 40,000 times.

The easiest methods of mounting, or fitting-up for use, minute lenses, is to put one between two pieces of brass, having coresponding holes cut in them of such a size as to hold the edge of the lens, or they may be fixed to a single bit of brass by a little gum.

Water Lenses.—Make a hole, about the size for a large pin to pass through, in a piece of thin brass—take up a minute drop of water with a pin's point, and place it on the hole, when it will assume a globular form, and be capable of showing with considerable distinctness microscopic objects placed beneath. This, besides being of such a temporary character, is subject to irregularities arising from the difficulty of holding it with the requisite steadiness,—the trembling occasioned by the breath, or accident,—by draughts of wind,—want of perfect sphericity of the hole, &c.

Varnish Lenses.—Sir D. Brewster long ago constructed fluid lenses in a different and superior manner. He placed minute drops of very pure turpentine varnish, and other viscid fluids, on plates of thin and parallel glass. By this means he formed plano-convex lenses of any focal length; and, by dropping the varnish on both sides, he formed double-convex lenses, with their convexities, in any required proportions. By freeing the glass carefully from all grease, with a solution of soda, the margin of the lenses was beautifully circular, and the only effect of gravity, which diminished with the viscidity of the fluid, and with the smallness of the drop, is to elongate the lower lens, and flatten the upper one. These lenses were found to answer well as the object glasses of compound microscopes.

Natural Lenses.—The crystalline lenses of minnows and small fishes may be taken out of the eye in a state of such perfection, that, when used as single microscopes, they give a very perfect image of minute objects. In such lenses, which have an increased density towards their centre, the spherical aberration is almost wholly corrected. Great care, however, must be taken to make the axis of the lens the axis of vision, to prevent its form from being injured by pressure against the aperture which holds it. The best way is to make a ring at the end of a piece of wire, having its diameter a little greater than that of the lens. A ring of viscid fluid, (gum water for example,) is then made to line the ring of wire and the lens is suspended in the ring of fluid, some of the fluid encroaching upon its anterior or posterior surface.

COLORED CLOUDS.

The rays from the rising and setting sun are refracted by our spherical atmosphere; hence the most refrangible rays, as the violet, indigo, and blue, are reflected in greater quantities from the morning and evening skies; and the least refrangible ones, as red and orange, are last seen about the setting sun. Hence Mr. Beguelin observed, that the shadow of his finger on his pocket book was much bluer in the morning and evening, when the shadow was about eight times as long as the body from which it was projected. Mr. Melville observes, that the blue rays being more refrangible are bent down in the evenings by our atmosphere, while the red and orange, being less refrangible, continue to pass on, and tinge the morning and evening clouds with their colors.—*See Priestley's History of Light and Colors, p.* 440.

But as the particles of air, like those of water, are themselves blue, a blue shadow may be seen at all times of the day, though much more beautifully in the mornings and evenings, or by means of a candle in the middle of the day. For if a shadow on a piece of white paper is produced by placing your finger between the paper and a candle in the day-light, the shadow will appear very blue; the yellow light of the candle upon the other parts of the paper apparently deepens the blue by its contrast, these colors being opposite to each other.

There is a bright spot seen on the corner of the eye, when we face a window, which is much attended to by portrait painters; this is the light reflected from the spherical surface of the polished cornea, and brought to a focus; if the observer is placed in this focus, he sees the image of the window; if he is placed before or behind the focus, he only sees a luminous spot, which is more luminous and of less extent, the nearer he approches to the focus. The luminous appearance of the eyes of animals in the dusky corners of a room, or in holes in the earth, may arise in some instances from the same principle; viz. the reflection of the light from the spherical cornea; which will be colored red or blue, in some degree, by the morning, evening, or meridian light, or by the objects from which that light is previously reflected. In the cavern at Colebrook Dale, where the mineral tar exudes, the eyes of the horse, which was drawing a cart from within towards the mouth of it appeared like two balls of phosphorus, when he was above 100 feet off, and for a long time before any other part of the animal was visible. In this case the luminous appearance is supposed to have been owing to the light, which had entered the eye, being reflected from the back surface of the vitreous humour, and thence emerging again in parallel rays from the animal's eye, as it does from the back surface of the drops of the rainbow, and from the water-drops which lie, perhaps without contact, on cabbage-leaves, and have the brilliancy of quicksilver. This accounts for this luminous appearance being best seen in those animals which have large apertures in their iris, as in cats and horses, and is the only part visible in obscure places, because this is a better reflecting surface than any other part of the animal. If any of these emergent rays from the animal's eye can be supposed to have been reflected from the choroid coat through the

semitransparent retina, this would account for the colored glare of the eyes of dogs or cats, and rabbits, in dark corners.

TEMPERATURE.

A DEFINITE degree of sensible heat, as measured by the thermometer. Thus we say a *high temperature*, and a *low temperature*, to denote a manifest intensity of heat or cold. According to Biot, temperatures are at the different energies of caloric in different circumstances. Different parts of the earth's surface are exposed, as is well known, to different degrees of heat, depending upon the latitude and local circumstances. In Egypt it never freezes, and in some parts of Siberia it never thaws. In the former country, the average state of the thermometer is about 72°.

The annual variation of heat is inconsiderable between the tropics, and becomes greater and greater as we approach the poles. This arises from the combination of two causes, namely, the greater or less directness of the sun's rays, and the duration of their action, or the length of time from sunrise to sunset. These two causes act together in the same place: that is, the rays of the sun are most direct when the days are longest, or at the solstice. But while, (the season being the same,) the rays become more and more oblique, and consequently more feeble as we increase our latitude, the days become longer, and the latter very nearly makes up for the deficiency of the former, so that the greatest heat in all latitudes is nearly the same. On the other hand, the two causes of cold conspire. At the same time that the rays of the sun fall more obliquely, as we increase our latitude, the days become shorter and shorter at the cold season; and according the different parallels are exposed to very unequal degrees of cold: while tropical regions exhibit a variation of only a few degrees, the highest habitable latitudes undergo a change amounting to 140°. Both heat and cold continue to increase long after the causes producing them have passed their maximum state. Thus the greatest cold is ordinarily about the last of January, and the greatest heat about the last of July. The sun is generally considered the only original source of heat. Its rays are sent to the earth just as the rays of a common fire are thrown upon a body placed before it; and, after being heated to a certain extent, the quantity lost by radiation equals the quantity received, and the mean temperature remains the same, subject only to certain fluctuations depending upon the season and other temporary and local causes. According to this view of the subject, the heat that belongs to the interior of the earth has found its way there from the surface, and is derived from the same general source, the sun; and in support of this position is urged the well-known fact, that, below eighty or one hundred feet, the constant temperature, with only a few exceptions, is found to be the mean of that at the surface in all parts of the earth. But how are we to explain the remarkable cases in which the heat has been found to increase, instead of decreasing, as we descend? We are told that in the instance of mines, so often quoted to prove an independent central fire, the extraordinary heat, apparently increasing as we descend, may be satisfactorily accounted for in a simpler way:—1. It may be partly received from the persons employed in working the mines. 2. The lights that are required in these dark regions afford another source of heat. 3. But the chief cause is supposed to be the condensation of the air, which is well known to produce a high degree of heat. The condensation, moreover, becoming greater and greater according to the depth, the heat ought, on this account, to increase as we descend; and as a constant supply of fresh air from above is required to maintain the lights, as well as for the purposes of respiration, at the rate of about a galloo a minute for each common-sized light and each workmon, it is not surprising, that the temperature of deep mines should be found to exceed that of the surface in the same latitude. This explanation of the phenomenon seems to derive confirmation from the circumstance that the high temperature observed is said to belong only to those mines that are actually worked, and that it ceases when they are abandoned. If we except these cases, and that of volcanoes and hot springs, the temperature of the interior of the earth seems to be the mean of that at the surface; and hence it is inferred that it is derived from the same source. The diurnal variation of heat, so considerable at the surface, is not to be perceived at the depth of a few feet, although here there is a gradual change that becomes sensible at intervals of a month. At the depth of thirty or forty feet, the fluctuation is still less, and takes place more slowly. Yet at this distance from the surface there is a small annual variation; and the time of midsummer, or greatest heat, is ordinarily about the last of October, and that of midwinter, or greatest cold, is about the last of April. These times, however, are liable to vary a month or more, according as the power of the earth to conduct heat is increased by unusual moisture or diminished by dryness. But at the depth of eighty or a hundred feet, the most sensible thermometer will hardly exhibit any change throughout the year. So, on the other hand, if we ascend above the earth's surface, we approach more and more to a region of uniform temperature, but of a temperature much below the former. The tops of very high mountains are well known to be covered with perpetual snow, even in the tropical climates. The same, or rather a still greater degree of cold, is found to prevail at the same height, when we make the ascent by means of a balloon. The tops of high mountains are cold, therefore, because they are in a cold region, and consequently swept by currents of cold air. But what makes the air cold at this height? It is comparatively cold, partly because it is removed far from the surface of the earth, where the heat is developed, but principally because it is rarefied, and the heat it contains is diffused over a larger space. Take a portion of air near the surface of the earth, and at the temperature of 79° of Fahrenheit, for instance, and remove it to the height of about three and a half miles, and it will expand, on account of the diminished pressure, to double the bulk, and the temperature will be reduced about 50°. It will accordingly be below the freezing point of water. This height varies in different latitudes and at different seasons. It increases as we approach the equator, and diminishes as we go towards the poles. It is higher, also, at any given place, in summer than in winter. It is moreover, higher when the surface of the ground below is elevated, like the table land of Mexico. At a mean the cold increases at the rate of about 1° for every 300 feet of elevation. In addition to the above it ought to be mentioned, that the tops of mountains part with the heat they receive from the sun more

readily on account of the radiation taking place more freely in a rarer medium, and where there are few objects to send the rays back again.

Continued on page 142.)

MISCELLANIES.

Origin of the Bat's Wing Gas Burner.—This excellent method of producing a large light with a small expenditure of gas, was discovered by accident, and shows the trivial circumstances from which the greatest improvements often arise. A brass-founder, who wished to exhibit to a friend the production of gas on a small scale, when it first came into use, had at hand only a burner, whose hole had accidently been stopped up; and not having any instrument at the time to unstop it, he in haste took hold of a saw which lay by him, and made a cross cut through the hole. When this was tried, he found to his great joy, that it produced the most brilliant effect; and being a collector of animals, he instantly compared it to the wing of a bat, which name the burner has kept ever since. His friends were anxious he should secure an interest in it by a patent, but he generously gave it to the trade at large.

The Spider.—Of all the insect tribes which come beneath the bane of vulgar prejudice, this is assuredly the most curious. First, the Barbary spider, which is as big as a man's thumb. This singular creature carries its children in a bag like a gipsy. During their nonage the young folks reside there altogether, coming out occasionally for recreation. In requital for this kindness on the part of their nurse, the young spiders, when they are full grown, become mortal foes to the parent, attack her with violence, and if they are conquerors dispose of the body as a fit subject for their next meal. Then there is the American spider, covered all over with hair, which is so large as to be able to destroy small birds, and afterwards devour them; and also the common spider, whose body looks like a couple of peninsulas with a little isthmus (its back) between.

Removal of Great Weights.—Is it not ridiculous that, in spite of our knowledge of the mechanical powers, nations in a semi-barbarous state should perform with ease and alacrity what our engineers fail to do? The famous gun Malik-e-meidan, or Lord of the Field, at Berjapoor, 14 feet 9 inches in length, with a bore of the diameter of 2 feet 5 inches, and 14 inches thickness of metal, was originally cast at Ahmednuggur, 150 miles from where it now lies, on one of the bastions of the wall of Berjapoor, yet the project of transporting it to England was, on account of its size and weight, given up in despair, as was also the case with the great gun at Agra, which has lately been blown to pieces. A large party of sailors and laborers were employed for a fortnight at Rangoon, in Birma, in transporting the large bell attached to the famous temple, a distance of a few yards to the river, in the middle of which they managed to deposit it, instead of in a brig as was intended. Despairing of success it was delivered over to the Birmese, who, in the course of *three days*, raised it from the bed of the river to its former situation in the temple.

Indelible Ink prepared from Vanadium.—The following account is given by Berzelius, of a new and almost indelible ink, applicable to all common purposes, which he has prepared from the recently discovered metal, vanadium. The vanadates of ammonia, that is the combinations of the acid, formed by this metal with oxygen, united to the alkali ammonia, when mixed with infusion of galls, form a black liquid, which is the best writing ink that can be used. The quantity of salt necessary for a perfectly black ink is so small, that it will be not worth considering, when vanadium is more generally known. The writing obtained with this ink is perfectly black. Acids render it blue, but do not obliterate it like common writing ink; the alkalies when sufficiently diluted not to act upon the paper, do not dissolve it, and chlorine, which destroys the black color, does not, however, efface the writing, even when water is afterwards suffered to run over it. In a word, if this ink is not perfectly indelible, it strongly resists reagents, which instantly cause common ink to disappear; added to which, it is blacker and flows better, because it consists of a solution, and not of a precipitate suspended in a solution of gum. It remains to be proved what the effects of time will be upon it.

To remove a Hard Coating or Crust from Glass and Porcelain Vessels.—It often happens that glass vessels, used as pots for flowers and other purposes, receive an unsightly deposit or crust, hard to be removed by scouring or rubbing. The best method to take it off, is to wash it with a little dilute muriatic acid. This acts upon it, and loosens it very speedily.—*Journal des Connaissances Usuelles.*

Scotch Method of Preserving Eggs.—Dip them, during one or two minutes in boiling water. The white of the egg then forms a kind of membrance, which envelopes the interior, and defends it from the air. This method is preferable to the varnish proposed by Reaumur.

Substitute for India Ink.—Boil in water, some parchment or pieces of fine gloves, until it is reduced to a paste. Apply to its surface while still warm, a porcelain dish which has been held over a smoking lamp: the lamp-black which adheres to it, will become detached and mingle with the paste or glue. Repeat the operation until the composition has acquired the requisite color. It is not necessary to grind it. It flows as freely from the pencil as India ink, and has the same transparency.

QUERIES.

98.—What is the cause of the rotary motion acquired by a watch glass when placed on an inclined looking glass, in its progress to the bottom? *Answered on page* 412.

99.—To what extent has carburetted hydrogen been compressed, has it ever yet been reduced to a solid or liquid, and if so, does it resume the aeriform state, on the pressure being removed? *Answered on page* 312.

100.—Is there any point in the mandril of a lathe which remains stationary, while the mandril revolves? *Answered on page* 176.

101.—What is the principle of the quicksilver heats? *Answered on page* 176.

102.—What is the difference between sheet and forked lightning, and the cause of that difference? *Answered on page* 207.

103.—Is there any rule for geometrically trisecting any rectilineal angle? *Answered on page* 207.

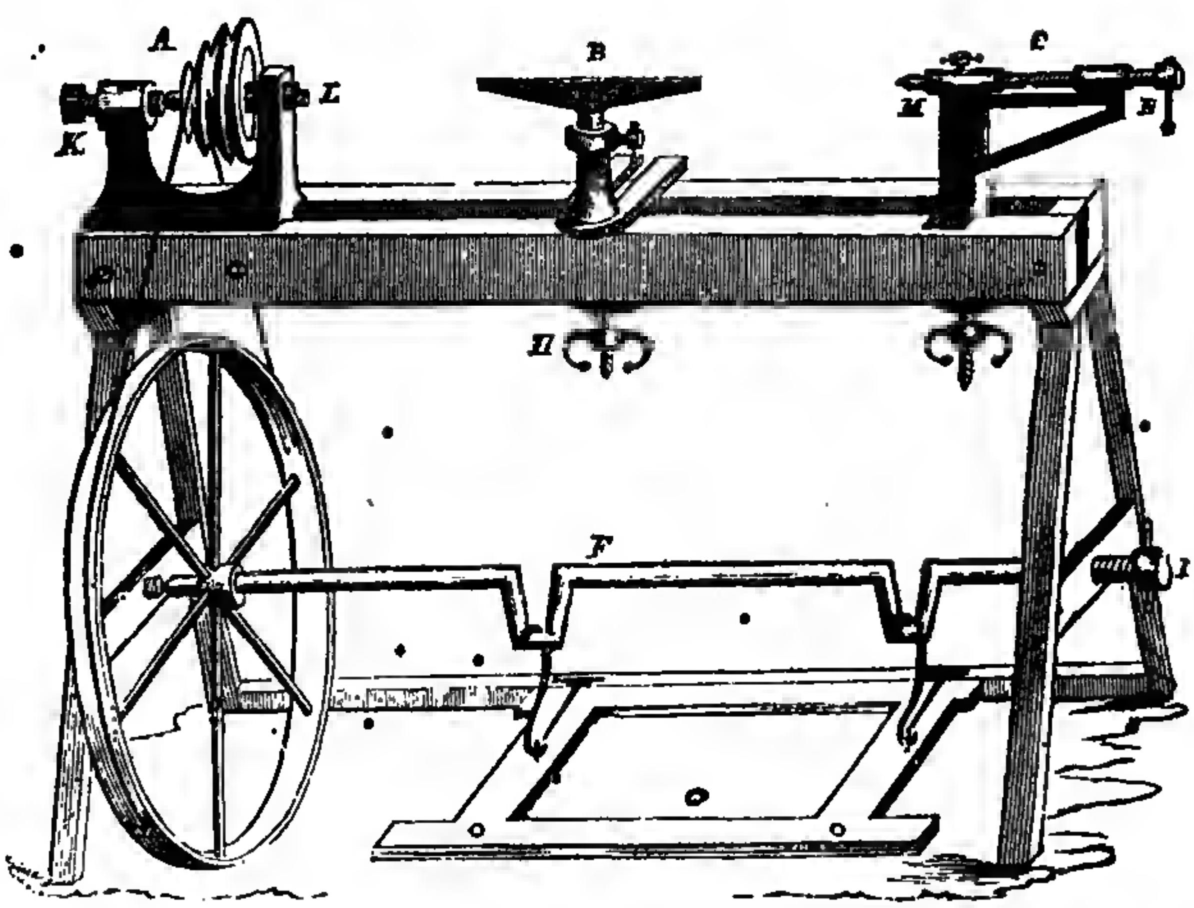
104.—What sort of gum or glue do modellers in card board use? *Answered on page* 160.

105.—How is hair sorted into lengths, and cleansed? *Answered on page* 359.

106.—What is the reason that a drop of glass being broken at the smaller end, flies into dust? *Answered on page* 312.

107.—Why may there not be invented a perpetual motion, and what is the nearest approach to it yet known? *Answered on page* 194.

108.—Why is snow white? *Answered on page* 207.



THE LATHE.

TURNING.

There is, perhaps, no contrivance with which human ingenuity has aided the dexterity of the mechanic more entitled to our admiration than the lathe: especially when we take into account all the improvements it has undergone, from its simplest and most ancient form in the potter's wheel, to that adaptation of varied and complex mechanism, by which not merely circular turning of the most beautiful and accurate description, but exquisite figure-work, and complicated geometrical designs, depending upon the eccentric and cycloidal movements, are daily produced.

The operation of turning differs very essentially from most others, in the circumstance, that the matter operated upon is put in motion by the machine, and is wrought by means of edge tools, presented to it, and held fast; whilst in most others the work is fixed, and the tool put in motion. In ordinary turning, the work is made to revolve on a stationary straight line as an axis, while an edge tool, set ready to the outside of the substance in a circumvolution thereof, cuts off all the parts which lie farthest from the axis, and makes the outside of that substance concentric with the axis. In this case, any section of the work made at right angles to the work will be of a circular figure; but there are methods of turning ellipses and various other curves, distinguished by the name of engine-turning.

Lathes are made in a great variety of forms, and put in motion by different means; they are called *centre-lathes* where the work is supported at both ends; *mandril, spindle*, or *chuck* lathes, when the work is fixed at the projecting extremity of a spindle. From different methods of putting them in motion, they are called *pole*-lathes, and *hand-wheel* lathes, or *foot*-lathes; for great works they are turned by horses, and water-wheels, but more generally by steam-engines. The lathes used by wood turners are usually made of wood in a simple form, and are called *bed*-lathes; the same kind will serve for turning iron and brass: but the best work in metal is always done in iron lathes, which are usually made with a triangular bar, and are called *bar*-lathes. Small ones, for the use of watch-makers, are denominated *turn-benches*: but there is no essential distinction between these and the centre lathes, except in regard to size, and that they are made in metal instead of wood, and the workmanship being more accurate and better finished.

The Centre Lathe is of all these machines the most simple. It consists of two upright blocks, or as they are called *puppets*, one of them moveable backwards and forwards, and both of them bearing a screw, which passes through them horizontally, and in a line with each other; these screws are pointed; and between the points the work to be turned is fixed, while a circular motion is given to it by a string passed once or twice round the work,

and fastened below to a treadle, the upper end of it going over a pulley and having a weight attached, or else fastened to an elastic pole, which draws the string back again when it has been forced downwards by the treadle. This lathe is now but little used, as it is not applicable to the general purposes of the turner, it being impossible to turn any delicate work, or that which is required to be hollow, even to turn a disk by means of the centre lathe is difficult, if not impossible.

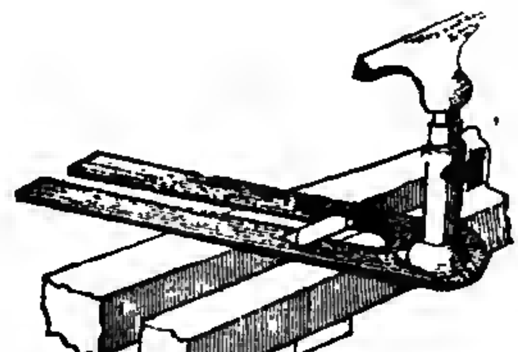
The Foot Lathe, with Mandril and Collar.—A lathe of this kind serves equally well for centre work and the more delicate and beautiful specimens of the art, whether of ivory, metal, or wood, and is that almost universally employed by the amateur, as well as the professed artizan. The introductory engraving, and following description which refers to it, will show the simplest construction, and being made almost wholly of wood, the amateur will have but little difficulty in making a great part of it himself, should it be desirable.

The bed of the lathe consists of two beams or cheeks fixed parallel to each other, and leaving a space of about $1\frac{1}{4}$ inch between them. The cheeks may be 3 feet long, 5 inches deep, and 2 inches thick, and made of yellow deal, or still better of oak. The bed of the lathe is supported by legs at the end, properly framed together, so as to bear the wheel, &c. afterwards to be mentioned.

A is the mandril, the most important part of the lathe,—it is usually fixed in a strong iron frame or bed, totally distinct from the wooden bed of the lathe itself, as is shown in the engraving. It consists of a spindle fixed in this iron frame, in a horizontal direction, made of iron, but bearing a steel point at one end, where it is supported by the screw K, and furnished at the other end or nose of the mandril, as it is called, with a screw L, to which screw, the work is afterwards to be attached by means of chucks, &c. Where it passes the inner leg of the iron support it works into a correctly turned steel collar, thus the spindle is capable of motion readily around its centre, but in no other direction. To give it this motion the spindle is furnished with a wheel of three or more differently sized grooves, over one of which a rope or catgut passes. This, which is called the lathe band, extends over a fly wheel placed beneath the bed, seen as connected with the axis and cranks F. The fly-wheel, which must be of considerable weight, is so much larger than the mandril wheel above, as to cause the latter to revolve many times during one of its own revolutions. The cranks are connected by bent iron links to the treadle G. The motion is therefore communicated from the workman's foot to the treadle G.; it passes through means of the cranks to the axis and wheel F, and then onwards to the mandril, and supposing a piece of wood be fastened to the screw L, it will of course turn round with equal velocity to the mandril with which it is in unison.

There are two other important parts of the foot lathe, the back puppet and the rest. The *back puppet* is shown at C. It consists of an iron or wooden support, capable of moving backwards and forwards in the groove between the two cheeks of the bed, and of being screwed down at any particular part by the hand-screw J. In the upper part is a spindle of iron M, moved backwards and forwards by the screw N: its object is to support the distant ends of any long body which is to be turned.

The spindle then which forms the axis, must be at the same height above the bed as the nose of the mandril and ought to run in a correct line with it, and be so accurately fitted into its socket as not to shake in the smallest degree in the after operation.



will be seen that by these simple movements the upper part may be fixed to any height, and in any position, by means of the smaller screw in the socket, while it moves to the requisite distance and situation by the screw below.

Practical observations on chucks, tools, and mode of operating will form the subject of future remarks, which we are induced the more readily to give, because there is no work on turning in the language, except one by Ibbetson, which is upon one branch only, and intended rather to give an account of a chuck of his invention, than to explain the general principles of the art.

LUMINOUS ANIMALS AND INSECTS.

The remarkable property of emitting light during life, is only met with amongst animals of the four last classes of modern naturalists, viz. mollusca, insects, worms, and zoophytes.

The mollusca and worms contain each but a single luminous species; the *pholas dactylus* in the one, and the *nereis noctiluca* in the other.

Some species yield light in the eight following genera of insects; *elata, lampyris, fulgora, pausus, scolopendra, cancer, lynceus,* and *limulus.* The luminous species of the genera lampyrus and fulgora, are more numerous than is generally supposed, if we may judge from the appearance of luminous organs to be seen in dried specimens. Amongst zoophytes we find that the genera *medusa, bereo,* and *pennatula,* contain species which afford light.

The only animals which appear to possess organization for the production of light, are the luminous species of lampyrus, elator, fulgora, and pausus.

The light of the lampyrides, (glow worms,) is known to proceed from some of the last rings of the

abdomen, which, when not illuminated, are of a pale yellow color. Upon the internal surface of these rings there is spread a layer of a peculiar soft yellow substance, which has been compared to paste, but by examination with a lens, it is found to be organised like the common interstitial substance of the insect's body, except that it is of a closer texture, and a paler yellow color. The segments of the abdomen, behind which this particular substance is placed, are thin and transparent, in order to expose the internal illumination. The number of luminous rings varies in different species of lampyris, and as it would seem at different periods in the same individual.

Besides the luminous substances above described, there may be discovered in the common glow-worm, on the inner side of the last abdominal ring, two bodies, which to the naked eye appear more minute than the head of the smallest pin. They are lodged in two slight depressions, formed in the shell of the ring, which is at these points particularly transparent. On examining these bodies under the microscope, it was observed that they were sacs, containing a soft yellow substance, of a more close and homogeneous texture than that which lines the inner surface of the rings. The membrane forming the sacs appeared to be of two layers, each of which is composed of a tranparent silvery fibre, in the same manner as the internal membrane of the respiratory tubes of insects, except that in this case, the fibre passes in a spiral instead of a circular direction. This membrane, though so delicately constructed, is so elastic as to preserve its form after the sac is ruptured, and the contents discharged. The light that proceeds from the sacs is less under the control of the insect than that of the luminous substance spread on the rings; it is rarely if ever entirely extinguished in the seasons that the glow-worm gives light, even during the day; and when all the other rings are dark, these sacs often shine brightly. The small sacs of luminous substances are not found in any species of lampyris, except the glow-worm of this country. Thunberg mentions that the lampyris japonica has two vesicles on the tail, which afford light.

The organs for the production of light in the genus elater are situated in the corcelet; these likewise consist of a peculiar yellow substance, placed behind transparent parts of the shell, which suffer the natural color of this substance to be seen through them in the day, and when illuminated give passage to the light. The most luminous species of this genus are *elater noctilucus*, *elator ignitus*, and *elater phosphorea.*

On desecting the organs of light in the elater noctilucus it was found that there is a soft yellow substance, of an oval figure, lodged in the concavity of the yellow spots of the corcelet, which parts are particularly thin and transparent in this species. This substance is so remarkably close in its structure, that at first view it appears like an inorganic mass, but with a lens it is readily perceived to be composed of a great number of very minute lobes, or lobules, closely pressed together. Around these oval masses the interstitial substance of the corcelet is arranged in a radiant manner, and the portion of the shell that immediately covers the irradiated substance, is in a certain degree transparent, but less so than that which lies over the oval masses; it is therefore probable that the interstitial substance in this situation may be endowed with the property of shining. A fasciculus of the muscles of the corcelet arises in the interior of the oval masses of the luminous substance, but not apparently with any design, as it contributes with the adjacent fasciculi to move the anterior feet.

The light in the genus fulgora, (lanthorn fly,) the candelaria and lanternaria, has been observed to issue from the remarkable proboscis on the fore part of the head. This part has always been described by authors as hollow or empty; and what is more extraordinary, that the cavity communicates freely with the external air, by means of a chink or narrow aperture, placed on each side of the proboscis. This projection is covered internally by a membrane, between which and the horny part or shell, there appears to be interposed a pale reddish colored soft substance, that is arranged in the candelaria in broad lines or stripes; but it is so thin, that its structure could not be distinctly examined, or absolutely determined, whether, it should be considered as a substance intended to furnish the light of these insects, or the pigment upon which the color of the proboscis depends.

The globes of the antennæ constitute the organs of light in the pausus spherocerus. Dr. Afzelius, who discovered the luminous property in this species, compares them to lanterns spreading phosphoric light. The rarity of the insect prevented the examination of its structure, but from the form and situation of its organs of light, it is most probable they are constructed like those of the fulgoræ.

It has been conjectured by Carradori and others, that the lampyrides were enabled to moderate or extinguish their light by retracing the luminous substance under a membrane; but neither in them, nor any of the other luminous insects, has an apparatus of this sort been discovered. The substance furnishing the light is uniformly applied to corresponding transparent parts of the shell of the insect, from whence it is not moved; indeed a membrane if it did exist, would have but little effect in obscuring the light, and never could serve to extinguish it. The regulation of the kind and degree of the luminous appearance, does not depend upon any visible mechanism; but, like the production of light itself, is accomplished by some inscrutable change in the luminous matter, which in some animals is a simple operation of organic life, and in others is subject to the will.

With the exception of the animals above mentioned the exhibition of light depend upon the presence of a fluid matter.

In the pholas dactylus the luminous fluid is particularly evident, and in vast quantity; it is recorded by Pliny that this fluid is like liquid phosphorus, and renders every object luminous with which it comes into contact. Reaumur also found that it was diffusible in water, or any fluid in which the animal might be immersed.

The shining of the scolopendra electrica is accompanied by the appearance of an effusion of a luminous fluid upon the surface of the animal, more particularly about the head, which may be received upon the hand, or other bodies brought into contact with the insect at the moment, and these exhibit a phosphoric light for a few seconds afterwards. This fluid however has never been discovered in the form of moisture, even upon the cleanest glass, although examined immediately with the most scrupulous attention by a lens; it must therefore be extremely attenuated. The same appearance has been observed during the illumination of nereis noctiluca by Fougeroux and Bondaroy

The animal discovered by Riville shed a blue liquor, which illuminated the water for a distance of two or three lines.

Spallanzani relates, that the medusa which he examined, communicated the property of shining to water, milk, and other fluids, on being rubbed or squeezed in them.

The luminous fluid is, in some instances, confined to particular parts of the body, and in others is diffused throughout the whole substance of the animal.

In the scolopendra electrica, it appears to reside immediately under the integument. In the lynceus discovered by Riville, it is contained in the ovary. Every part of the body of the medusæ is furnished with this fluid, as there is no part but what has been seen illuminated under different circumstances; though Spallanzani affirms that it is only found in the large tentacula, the edges of the umbella, and the purse or central mass; which be proved, he says, by detaching these parts successively, when they shone vividly, while the rest of the body neither gave light, or communicated any luminous appearance to water.

Spallanzani discovered a mucous luminous fluid in the plumule of the pennatula phosphorea.

The phenomenon of animal light has been attempted to be explained in different ways. By many persons it was formerly ascribed to a putrefactive process; but since the modern theories of combustion became known, it has been generally believed to depend upon an actual inflammation of the luminous substance, similar to the slow combustion of phosphorus. Others have accounted for the luminous effect, by supposing the matter of light to be accumulated, and rendered latent under particular circumstances, and afterwards evolved in a sensible form.

The opinion of the light of living animals being the consequence of putrefaction is evidently absurd and contradictory to all observations on the subject. It has been proved by the experiments of Dr. Hulme, and others, that even the luminous appearance of dead animals are exhibited only during the first stages of the dissolution of the body, and that no light is omitted after putrefaction has really commenced.

Spallanzani, who was the most strenuous advocate for the phosphorescent nature of animal light, stated that the glow-worms shone more brilliantly when put into oxygen gas; that their light gradually disappeared in hydrogen or in azotic gas, and was instantly extinguished in fixed air; that it was also lost by cold and revived by the application of a warm temperature. He conjectured that the luminous matter of these insects was composed of hydrogen and carbonated hydrogen gas.

Forster relates, in the Lichtenbergh Magazine for 1783, that on putting a lampyris splendidula into oxygen gas, it gave as much light as four of the same species in common air.

Carradori has made some experiments upon the lucciole, (lampyris italica,) which led him to deny its phosphorescence. He found that the luminous part of the belly of the insect shone in vacuum, in oil, in water, and different liquids, and under different circumstances, where it was excluded from all communication with oxygen gas. He accounts for the result of Forster's experiment, by supposing that the worm shone more vividly, because it was more animated in oxygen gas than in common air.

Carradori adopts on this subject the doctrine of Brughatelli, and ascribes the luminous appearance of animals to the condensation and extrication of light in particular organs, which had previously existed in combination with the substance of their bodies. He supposes the light to be originally derived from the food, or in the atmospheric air taken into the body; in short, that certain animals have the peculiar property of gradually imbibing light from foreign bodies, and of afterwards secreting it in a sensible form.

Various experiments on the luminous medusæ were made at Herne Bay, with the assistance of George May, Esq., of Stroud House, and in the presence of a large company, capable of accurately distinguishing their results. From which it appears, that so far from the luminous substance being of a phosphorescent nature, it sometimes shows the strongest and most constant light when excluded from oxygen gas, that it in no circumstances undergoes any process like combustion, but is actually incapable of being inflamed; that the increase of heat, during the shining of the glow worm, is an accompaniment, and not an effect of the phenomenon, and depends upon the excited state of the insect; and, lastly, that heat and electricity increase the exhibition of light, merely by operating like other stimuli upon the vital properties of the animal.

Spallanzani's experiments of diffusing the luminous liquor of the medusæ in water, milk, or other fluids, are in direct contradiction of his own theory, as is also the extinction of the light of these mixtures by the application of a high degree of heat.

If the light emitted from animals were derived from their food, or the air they respire, as supposed by Carradori, the phenomenon should be increased or diminished, according to the quantity of food or air that the creatures consume; but we do not find this to be the case, for in those situations where they are sometimes found to be most luminous, they are deprived in a great measure of these assumed sources of their light.

In fact, the luminous exhibitions of living animals are not only independent of all foreign light, but are frequently destroyed by the latter. The shining of the medusæ ceases upon the rising of the moon, or at the approach of day: and when out of the sea they never can be excited to throw out light until they had been kept some time in the dark; all the luminous insects likewise secrete themselves as much as possible during the day time, and go abroad only at night. The scopulendra electrica indeed will not shine unless it has been previously exposed to solar light; but it has been observed to shine as brilliantly and as frequently, after being kept a short time in a light situation, as when left uncovered the whole day; the circumstance of the scolopendra requiring exposure, previous to its giving out light, is very unaccountable, as the insect, when left to itself, always seeks as much as possible concealment during the day—indeed it is the opinion of some naturalists that it is killed by the light of the sun.

The following is an enumeration of the several conclusions that are the result of observations made upon the phenomena of animal light.

The property of emitting light is confined to animals of the simplest organization, the greater number of which are inhabitants of the sea. The luminous property is not constant, but, in general, exists only at certain periods, and in particular states of the animal's body. The power of showing light resides in a peculiar substance, or fluid, which is sometimes situated in a particular organ, and at

others diffused throughout the animal's body. The light is differently regulated when the luminous matter exists in the living body, and when it is abstracted from it. In the first case it is intermitting, or alternated, with periods of darkness; is commonly produced, or increased, by a muscular effort, and is sometimes absolutely dependent upon the will of the animal. In the second case the luminous appearance is usually permanent until it becomes extinct, after which it may be restored by friction, concussion, and the application of warmth, which last cause operates on the luminous matter (while in the living body) only indirectly by exciting the animal. The luminous matter in all situations, so far from possessing phosphoric properties is incombustible, and loses the quality of emitting light by being dried or much heated. The exhibition of light, however long it may be continued, causes no diminution of the bulk of the luminous matter. It does not require the presence of pure air, and is not extinguished by other gases.

The luminous appearance of living animals is not exhausted by long continuance, or frequent repetitions, nor accumulated by exposure to natural light; it is therefore not dependent upon any foreign source, but inheres as a property in a peculiarly organized animal substance or fluid, and is regulated by the same laws which govern all the other functions of living beings.

The luminous property does not appear to have any connection with the economy of the animals that possess it, except in the flying insects, which by that means discover each other at night for the purpose of sexual congress.—*Abridged from the Nautical Magazine.*

GROWING PLANTS IN WATER.

THE growing of hyacinths and other bulbs, in water glasses, that they may decorate our apartments during that season when external nature is dead and dreary, has of late years been of common practice. Lately the phenomena involved in the progress of vegetable germination and growth, has more than ever been subjected to observation, by the successful attempt of some persons to grow young oaks in water, and to propagate cuttings of ordinary plants in the same medium.

The following practical observations and remarks on the vegetative principles, called into action during the first growth of roots, may be useful not merely to the amateur gardener, but interesting to the botanist and general observer.

One of the conditions of germination is the exclusion of light, as was long ago satisfactorily proved, by Ingenhoutz and Senebier. The truth of this, taken in its fullest extent of meaning, has been doubted, though its general application is beyond cavil or dispute. Thus even the floating water plants, as, for example, the duck-weed, although when grown it is seen upon the surface of our ponds, and exposed to the direct light of a meridian sun, yet, when young, and while roots are protruding themselves, it lies carefully upon the mud at the bottom. This is not merely supported by arguments drawn from a particular class of vegetables, but may be proved by direct experiment.

Place a hyacinth root in a white transparent glass, and another in a blue glass, both being exposed to the light; let them be examined from time to time, when it will be found that that in the blue glass will have the roots not merely more vigurous, but long before the other. If a third root had been placed, at the same time, in another white glass, and that suffered to remain in some dark place, the roots would be found still more grown, making allowance of course, if necessary, for freedom of air, and any variation of temperature. Throughout all vegetable nature the principle is apparent, and why? Merely because light is too great a stimulus to the young and tender roots, they require but moisture and warmth—thus all seeds in germination throw their roots downwards, and whatever position they may be in, yet they seek darkness with equal avidity as the stems, leaves, and flowers, afterwards to be produced, will, in due time, offer themselves unshrinking to the summer's sun. After a time light does not appear to have so injurious a tendency upon the plant—thus hyacinths begin to germinate badly in white glasses, and often even rot off before any roots are projected, but when once radicles are apparently vigorous, no danger of rotting is to be apprehended, but they will flower almost equally well, whether exposed to light or not, and to the well-being of the flowers and leaves light is indispensably necessary.

Those, therefore, who would have healthy winter flowering bulbs, (of which the principle sorts are hyacinths, narcissus, crocus, early dwarf tulip, and the jonquil,) must place the glasses which contain them, for some time, in darkness, either in a warm cellar, or if in a room by covering the glass with dark paper. When the roots are two or three inches long the glass may be brought into the parlour, or, if there, the paper removed from them. Gardeners usually put the roots in the ground for a fortnight before placing them in water. When in the glasses the water should only reach up to the lower part of the bulb—otherwise it will be apt to rot by excess of moisture.

This last principle must be acted upon in the growth of seeds under similar circumstances. There are but few seeds which will germinate wholly under water. Those of water plants usually fix themselves at the bottom of ponds, &c., and there expand, but that is not the case with plants in general. Du Hamel found that peas, which he placed merely upon a piece of wet sponge, so as to immerse them by nearly one half, germinated as if in the soil; but this was the most they could bear, for when totally immersed in the water they rotted. A common experiment shows this forcibly:—Cover a bottle with flannel, rub over it some mustard seed, and place it in a pan of water. All the seeds above the surface being kept moist by the flannel, germinate, while those below the water remain dormant, or rot away; and this experiment equally proves the necessity of darkness, as the seeds upon a bottle so prepared, will, in the dark, grow twice as fast as if in the sunshine. Nature always chooses her own appointed time for all things. Seeds grow but in the spring—bulbs send downwards their roots during the damps of autumn, after having passed a period of repose—should either be retarded beyond the natural period, though vitality may not be destroyed, yet it becomes languid, and if kept long in this unnatural state of torpidity, or if prevented from enjoying it at a proper season, they can scarcely be expected to produce vigorous plants; bulbs keep dormant during the autumn, when they ought to be growing, or left in the ground, and watered during summer

and thus thrown prematurely into action, will seldom flower well the following season. The early part of November for bulbs, and the early part of February for seeds in general, will best succeed.

An acorn, suspended by a thread in a hyacinth glass, and half immersed in water will then grow vigorously, and form a pretty object. The seeds of peas and beans, of most other leguminous plants, of wheat, oats, and other of the grasses; and, indeed, all quick-growing seeds will answer well for this purpose—such as are small may be placed upon a bit of cork, covered with flannel, and left floating.

The seeds of rice before the husks are taken off, and which is then called *paddy*, grows well when scattered among cotton wadding, and this kept in a glass of water.

This is an extremely interesting method of propagation, and will succeed with many seeds, roots, and cuttings, though the glass of water is not necessary. Thus a crop of corn, or potatoes, may be produced, by wrapping up the seed of the first, or a small root of the other, in a ball of cotton wadding, suspending it from the ceiling, and keeping it well watered: an acorn will grow thus, and mignionette seed also; so will various cuttings, particularly of the willow—the pipings of pinks—the roots of crocuses and snow drops—of the bulbous-rooted iris—of the ginger—the stems of succulents, &c.; and as to the parasitic orchideous plants, the customary method of cultivation is to place them on pieces of wood, or in little baskets of moss, kept watered at stated periods, according to the nature of the particular species growing.

Thus in the apparently-simple process of growing bulbs in glasses, philosophical principles must be considered, and he who will succeed in managing the vital objects of nature, however indifferent he may think them to minor circumstances of soil or situation, yet the laws of organization, preservation, and increase must not be infringed upon with impunity, or disappointment will attend even his greatest labor and assiduity.

(*Continued on page* 147.)

TEMPERATURE.

(Resumed from page 136, *and concluded.)*

The question has been much discussed, whether the winters in the temperate latitudes have become milder or not. There is abundant evidence, it seems to us, in favor of the alleged change. Rivers which used to be frozen over so as to support armies, and which were expected to be covered in the winter season with a natural bridge of ice, as a common occurrence, now very rarely afford such facilities to travellers. The directions for making hay and stabling cattle, left us by the Roman writers on husbandry, are of little use in modern Italy, where, for the most part, there is no suspension of vegetation, and where the cattle graze in the fields all winter. The associations with the fireside, annually referred to as familiar to every one, can be little understood now in a country where there is ordinarily no provision for warming the houses, and no occasion for artificial heat as a means of comfort. The ancient custom of suspending warlike operations during the season of winter, even in the more southern parts of Europe, has been little known in campaigns of recent date; not because the soldier of our times is inured to greater hardships, but because there is little or no suffering from this cause. In the northern parts of America, also, the lapse of two centuries has produced a sensible melioration. When New England was first settled, the winter set in regularly at a particular time, continued about three months without interruption, and broke up regularly, in the manner it now does in some parts of Canada and Russia. The quantity of snow is evidently diminished, the cold season is more fluctuating, and the transition from autumn to winter, and from winter to spring, less sudden and complete. The period of sleighing is so much reduced and so precarious as to be of little importance compared with what it was. The Hudson is now open about a a month later than it used to be. We are not, however, to conclude that so great a melioration has taken place as might at first be inferred from this fact. The change, whatever it be, seems to belong to the autumn and early part of winter. The spring, we are inclined to believe, is even more cold and backward than it used to be. The supposed mitigation of winter has usually been ascribed to the extirpation of forests, and the consequent exposure of the ground to the more direct and full influence of the solar rays; and there can be little doubt that a country does actually become warmer by being cleared and cultivated. The favorable change experienced in New England, and the Middle States, may, it is thought, be referred to this circumstance. But the alteration that is observed in the similar latitudes of Europe can hardly be accounted for in this way. It is doubtful whether Italy is more clear of woods, or better cultivated, now, than it was in the Augustan age. No part of the world, it is believed, has been cultivated longer or better than some parts of China; and yet that country is exposed to a degree of cold much greater than is experienced in the corresponding latitudes of Europe.

The science of astronomy makes us acquainted with phenomena that have a bearing upon this subject. The figure of the earth's orbit round the sun is, such that we are sometimes nearer to this great source of heat by 3,000,000 of miles, or one thirtieth of the whole distance, than at others. Now it so happens that we have been drawing nearer and near to the sun, every winter for several thousand years. We now actually reach the point of nearest approach about the first of January, and depart farthest from the sun about the first of July. Whatever benefit, therefore, is derived from a diminution of the sun's distance, goes to diminish the severity of winter; and this cause has been operating for a long period, and with a power gradually but slowly increasing. It has, at length arrived at its maximum; and is beginning to decline. In a little more than ten thousand years, this state of things will be reversed, and the earth will be at the greatest distance from the sun in the middle of winter, and at the least distance in the middle of summer. We are speaking, it will be observed with reference to the northern hemisphere of the earth. The condition alluded to, to take place after the lapse of ten thousand years, is already fulfilled with regard to the southern portions of our globe, since their winter happens at the time of our summer. How far the excessive cold which is known to prevail about Cape Horn and other high southern latitudes may be imputed to this, we are not able to say. There is no doubt that the ice has accumulated to a much greater degree and extended much farther about the south pole than about the north. Commodore

Byron, who was on the coast of Patagonia, December 15, answering to the middle of June with us, compares the climate to that of the middle of winter in England. Sir Joseph Banks landed at Terra del Fuego, in lat. 50°, January 17, about the middle of summer in that hemisphere; and he relates that two of his attendants died in one night from the cold, and the whole party was in great danger of perishing. This was in lower latitude by nearly 2° than that of London. Captain Cook, in his voyage towards the south pole, expressed his surprise that an Island of no greater extent than seventy leagues in circumference, between the latitudes of 54° and 55°, and situated like the northern parts of Ireland, should in the very height of summer, be covered many fathoms deep with frozen snow. The study of the stars has made us acquainted with another fact connected with the variable temperature of winter. The oblique position of the earth's axis with respect to the path round the sun, or what is technically called the *obliquity* of the *ecliptic*, is the well known cause of the seasons. Now this very obliquity, which makes the difference as to temperature between summer and winter, has been growing less and less for the last 2,000 years and has actually diminished about one eightieth part, and must have been attended with a corresponding reduction of the extremes of heat and cold. It still remains for us to inquire how it happens that the extremes of heat and cold in America are so much more intense than they are in Europe under the same parallels. The thermometer, in New England, falls to zero about as often as it falls to the freezing point in the same latitude on this side of the Atlantic. The extreme heat of summer also is greater by 8° or 10°. This remarkable difference in the two countries, as to climate, evidently arises from their being situated on different sides of the ocean, taken in connexion with the prevalence of westerly winds. With America a west wind is a land wind, and consequently a cold wind in winter and a warm wind in summer. The reverse happens on this side of the Atlantic. Here, the same westerly current of air, coming from the water, is a mild wind in winter, and a cool, refreshing breeze in summer. The ocean is not subject to so great extremes of heat and cold as the same extent of continent. When the sun's rays fall upon the solid land, they penetrate to only a small depth, and the heat is much more accumulated at the surface. So, also during the long cold nights of the New Continent, this thin stratum of heated earth is rather rapidly cooled down than the immense mass of the ocean through which the heat is diffused to a far greater depth. At a sufficient distance from land, the temperature of the sea in the temperate latitudes, is seldom below 45° or above 70°; that is, the ocean is exposed to an annual change of only 25° or 30°, while the continent, in the same latitude, is subject to a variation of 100° or more.

WAXEN FLOWERS.

One of the most fashionable and ornamental arts of modern times is the making of artificial flowers in wax, a process chiefly practised by ladies, and one which is particularly adapted to call into exercise their acknowledged superior taste and delicacy of touch, and that it should have become so favorite an amusement with them cannot be wondered at considering the beauty and variety of the choice gems of the garden, and the fidelity with which they may be imitated. The process too is easy, involves no study, causes no dirt, and is attended by little expense. The following is a description of the materials and of the manufacture.

It is requisite to have a piece of wire about three inches long, pointed at one end, and with a round knob of sealing wax, about a quarter of an inch diameter, at the other, so that it resembles a very large pin; and three or four small smooth rods of wood of different sizes; these with a pen-knife or scizzars, are the only tools:—have also some very thin tin or brass to cut up into patterns, some wire of different sizes covered with silk for stems, and some sheets of wax of requisite colors: thus furnished set to work. Take a natural flower, as for example a primrose which consists of a green cup or calyx, withinside which are five petals, or straw-colored flower leaves, and in the centre five stamens. Pluck the flower to pieces, and after flattening each part either by putting it between the leaves of a book, or under a warm flat iron; cut out of the thin tin, patterns exactly similar to the calyx (allowing here a little to fold over when bent afterwards to the proper shape) and one of the petals. Then laying them upon the wax lengthwise of the sheets, cut out the calyx and the five petals. Take a piece of proper sized wire for the stalk, and cut five narrow thread-like strips of dark yellow wax for the centre, which fix on the top of the wire by the hard pressure of the thumb and the finger; these being on regular and firm, fasten on one of the petals in the same manner by pressure; then a second petal, a third, fourth, and fifth, putting them regularly round and bending each where it joins the stem outwards, so that when completed, the flower shall be flat. If the wax should be brittle, hold it in the palm of the hand for a minute, the warmth of this will render it so pliant as to yield readily to any pressure given to it. The petals being fixed, warm the calyx by the hand, and form it into a proper shape on the end of one of the little round and smooth rods of wood before-mentioned: slip it on by the lower end of the stalk, and when in its proper position, pinch it tightly round the end, which will fix the whole together, and the flower will be complete, except a few touches of a darker yellow, near the centre on the petals: this may be done either with oil-colors, or water-colors, mixed with ox-gall.

All this is easy, and there are many flowers that require no more care than this, such for example as the violet; the heartease; the snowdrop; the crocus; the polyanthus; the narcissus; the hyacinth; the tulip; the laburnum flower; the pink, &c. In some of these, however, there are several florets, each must be made separately, and the thin wires of each tied together by green silk.

The petals of the ranunculus and tulip are hollow, so they are in the rose, and usually in the crocus: this shape is given to them easily by the finger thus—hold the wax petal in the hand till it is pliable, then roll the central part of it with the sealing wax end of the wire pin, which will of course expand it somewhat, then press it with the point of the fingers into the hollow of the hand, which will make it of the requisite concave form. Sometimes the petals should appear rough and corrugated, as in the holyoak, the gum-cistus, and the red poppy,—roll it well so as to be very thin and warm, then crumple it up somewhat by the hand, and open it out into its proper form again, when, if done well, it will be ready for use. If a part of the flower resembles a cup, as the centre of the narcissus, it must be formed with the pin as before, the piece of wax being of the size

of the cup when cut open. In making a convolvulus it would be in vain to attempt forming it out of a round or flat piece of wax; the original flower must be cut down on one side, then laid out to flatten, the wax cut of the proper size, and folded carefully over a mould which has been soaking in milk-warm water; the mould previously made by pouring plaster of Paris carefully into a real flower of the same species. Some persons make the convolvulus flower in five sections, and putting these on the mould so that the edges unite, join them together very carefully, and hide the joint on the inside of the flower by placing over them five strips of wax differently colored, to imitate the rays seen upon the disk.

Dahlias, chrysanthemums, and other flowers, that are quilled; that is, have their petals bent in at the edges, must have each separate petal rolled by one of the sealing wax knobs, as for other things, and while warm the edges bent or rolled up with the fingers into proper shape. A large dahlia requires about seven sheets of wax, and requires petals of five or six sizes for different parts of the flower, and in the centre of it a lump of green wax, made of the refuse pieces, of about half an inch diameter. Roses, and other delicately-tinted flowers, are mostly made of white wax tinted by powder colors, put on with a short-haired, rather hard brush, such as is used for oriental tinting.

Flowers that are party-colored, or streaked, must have the streaks painted upon them. Single flowers will require stamens in their centres; these if very small, or so hidden as not to be conspicuous, may be made of narrow strips of wax of proper color, which will be much improved in appearance, if when fixed the ends of them be tipped with gum-water and fine crumbs of bread mixed with turmeric be sifted upon them. If the stamens are large they must be formed separately upon fine wires, by moulding between the thumb and finger some of the refuse wax of proper color, dipping each afterwards, if necessary, in a powder of the natural color. as in dark yellow for the lily, black for the tulip, &c.

The leaves that are attached to the various groups are almost all of cambric, and the manufacture of the artificial flower makers. A far superior method, however, is to cast them in moulds, such as are described further on, (p. 159)—In fact, some leaves can only be made effective by this method. Other leaves may be made of the same sheets of wax of which the flowers themselves are composed, such for exple, those of hyacinths; or if this should be considered too expensive, paper which is colored on both sides, if cut of a proper shape and afterwards dipped in melted white wax, will have a good effect. Dipping the cambric leaves in white wax, thus giving them a thin coat of that transparent material will add much to their general effect. Flowers are sometimes wholly made of paper dipped in wax, for this purpose colored tissue paper is generally used.

MISCELLANIES.

Action of Cold Air in increasing Heat.—A rod of iron, about an inch in diameter, was heated at one end in a forge fire, up to a full white heat, then quickly withdrawn from the fire and exposed to a strong blast of cold air from a forge bellows; the iron immediately became so hot as to fuse, and the liquified matter was blown off and burnt in the air, with the scintillating appearance of iron-wire burnt in oxygen gas; and so continued to melt until a pound or more of the metal had been thus wasted.

Another mode of producing the same action consisted in heating a rod of iron as before, but instead of a blast of air, it was tied to a cord, and by it whirled round in a vertical plane; thus, by passing swiftly through the cold air, it melted, and was thrown off in beautiful scintillations, appearing as luminous tangents to the circle in which the bar was moved.

The cause of this augmentation of temperature is, perhaps, referable to the oxidation of the metal, which takes place freely under the conditions of the experiments here recorded. Then, as is well known, the formation of the oxide is accompanied with a great developement of heat; and these cases are striking examples of the heating influence by chemical action, predominating over the cooling effect o. the air, conjoined with the radiating force.

Decomposition of Sugar.—Sugar is a compound of water and charcoal; and if you take a little finely-powdered lump sugar, and drop it into sulphuric acid, the acid, in seizing the water, will liberate the charcoal in its black form.

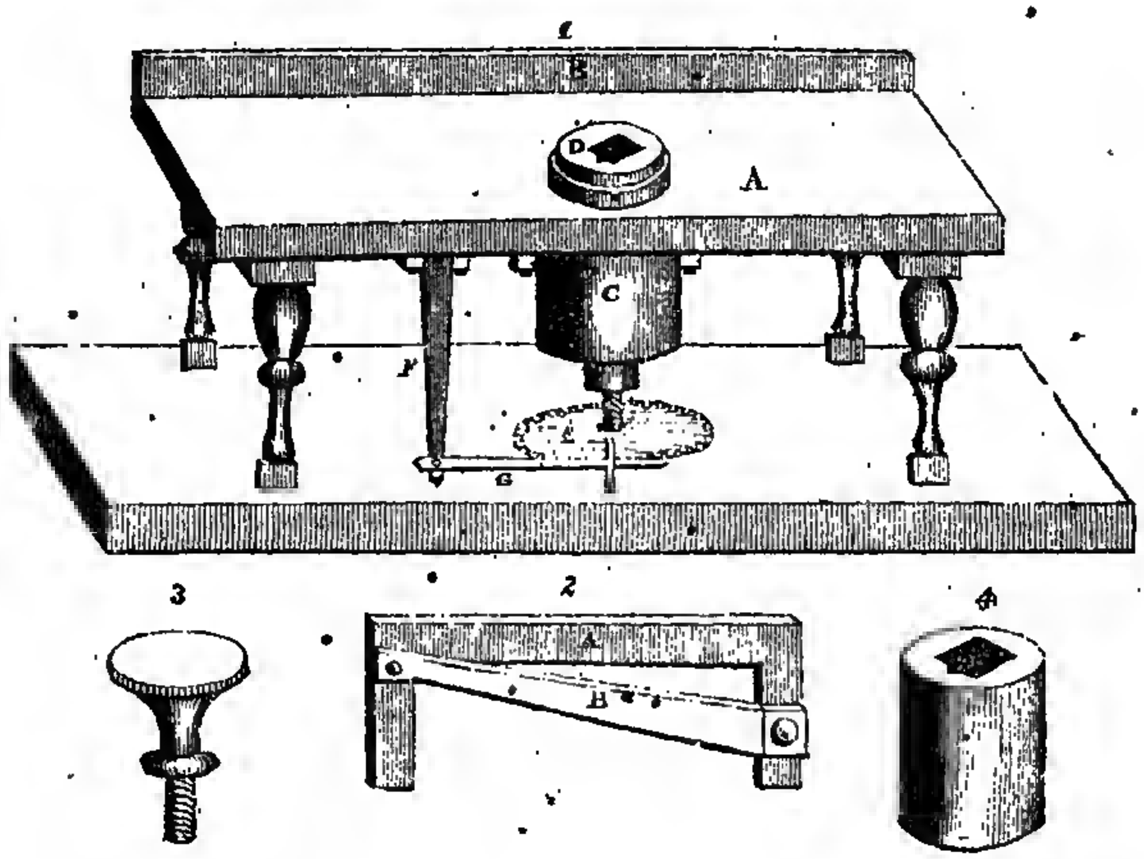
Or you may render the experiment still more striking, if you dissolve a large quantity of loaf sugar in a very small quantity of water, so as to make a strong syrup: by doing this you will entice the sulphuric to snatch away the water very rapidly, and the combined and really elementary water of the sugar will also follow it, and charcoal will remain behind.

This you must perform as follows:—Take a six-ounce gallipot, and stand it in a basin or soup plate filled with water; pour about an ounce of strong syrup into it, and add to this two ounces o. strong sulphuric acid; at first there appears to be little attraction between the two bodies, but now stir them together with a long glass rod; they will presently blacken, grow intensely hot, and ultimately a vast quantity of charcoal will be evolved in the black and solid form.

This is a very beautiful, and almost magical experiment, and it is an excellent illustration of the total change of form which bodies sustain when made to act chemically upon each other.

If the acid is very strong, the action often takes place with such vehemence that portions of the materials are spurted out of the vessel; therefore you must guard against this, not only by putting the gallipot in a basin or plate, but by placing this under the chimney, and stirring the materials with the glass rod held at arm's length; never hold your face over any apparatus in which an experiment is

Crystals in Living Vegetables.—Various naturalists have taken notice of the appearance of crystals in the internal parts of vegetable tissues, but nothing very explicit and certain has been stated respecting them. M. Turpin has discovered, in the cellular tissue of an old trunk of the Cereus Peruvianus, in the Garden of Plants at Paris, where it had been growing one hundred and thirty years, an immense quantity of agglomerations of crystals of oxalate of lime. They are found in the cellular tissue of the pith and bark. They are white, transparent, four-sided prisms, with pyramidal terminations, collected in radiant groups.



CUTTING MICROSCOPIC OBJECTS

In the general collection of objects which accompany microscopes from the opticians, there is usually a great paucity of those of a vegetable origin, and should they be purchased separately they are generally but little to be depended upon, even for names —less for showing the organic structure of the plants. It is but seldom that amateurs can supply themselves with these very interesting objects, for two reasons; one because the amateur, unless a botanist, knows not how to select them; or knowing this, he is not aware of the simple methods employed to prepare such as are to be shown in sections. We, therefore, trust that science may be promoted, and amusement increased, by a description of a machine for cutting sections of wood for the microscope, and by making a few remarks upon the vegetable organization displayed by those sections, when viewed by the transmitted light of the instrument.

Fig. 1.—A is a thick plate of brass, about eight inches long and three inches wide, ground perfectly level at the top, and supported by four legs, which rest upon a rather larger board below. B is a ridge of brass, fastened on one side of A, and standing up about half an inch. This is intended as a guide for the tool afterwards to be described. C is a cylindrical socket of brass, fastened to the underside of A, and projecting above the upper surface, about an eighth of an inch. On the lower part of C is a female screw, in which the male screw, attached to the cog wheel E, moves up and down. D, and also Fig. 4, is a solid cylinder of brass, fitting accurately, but easily, into the hollow of C, which hollow it also corresponds to in length—it has a hole, about half an inch square down the centre. Into this hole the wood to be cut is fastened, by means of a small wedge driven into the notches, represented on one side of it. Thus D, with the wood within it, moves up and down as the screw below is turned one way or the other, and according to the relative size of the screw thread, compared to the number of notches on the cog wheel, so D will be elevated at pleasure, and the wood within it cut to any degree of tenuity, even to so little as the five-hundredth part of an inch in thickness. F is an arm of brass, which extends downwards for the purpose of holding the spring G—the object of which is to shut in between

two of the cogs, and to hold the wheel E firm while a section is being made; also, to insure steadiness in the wood itself when the knife passes over it. On the outside of D is placed a stud, which moves up and down in a groove cut in C, and which is seen as a small square black mark on the upper part.

Fig. 2 is the knife employed. A is a frame of brass, five inches and a half long, ground very accurately level at the bottom and side—upon this is fastened a steel knife, with a broad blade and keen edge; it is attached by a thumb-screw, (a section of which is seen at Fig. 3,) at each extremity of the frame.

When the machine is to be used, the wood is to be prepared by soaking it in water for some hours, according to its condition or hardness, and fixed into the square hole prepared for it, so as to stand a quarter of an inch above the surface of D—turn backwards the screw E, so that D shall descend as much as possible. Then oil the surface of A, and place the knife and frame, Fig. 2, upon it, (having placed the machine upon a table, and standing at that end of it nearest A,)—slide the knife forward, and adjust the height of the wood so as just to meet the blade by the screw beneath. All is now adjusted. Hold back the spring with one finger—turn the wheel two or three notches, and let the spring fall back again. This having raised the wood a trifle, a section may be cut by passing the knife quite along over it. Draw the knife back, project the wood as before, and pass the knife along, and a second section is, in like manner, produced; and thus until all the wood is shaved away. The only care requisite is to have the knife very sharp—to hold it steadily by means of the thumb-screws—and to regulate the thickness of the cuttings by turning the cog wheel, more or less, according to circumstances, as may be found best to succeed.

The sections should generally be about a three-hundredth part of an inch in thickness, and as a general criterion to know their quality, it may be observed, that if they float in water they will be good, if not, they must be rejected as useless. A regular degree of thickness throughout is also requisite. After being cut the sections should be cleared of all extraneous matter—if they are from the stems of herbaceous plants, soaking for a few minutes in a wine glass of warm water will suffice—if of resinous substances, immersion in boiling alcohol is advisable; and boiling nitric acid, supposing the whole should be hard and fibrous, may often be used to advantage.

Some persons content themselves with the transverse section of a branch or stem, desiring only to witness the general arrangement of the vessels; but these convey only a partial idea of the real character of vegetable organization, and, in some instances, tend to mislead rather than to instruct, as without longitudinal sections the true nature of the vessels cannot be ascertained. The philosophic inquirer will choose to have three sections, that he may examine nature under every aspect—one cut transversely, and two longitudinal: one of which is to be in the direction of the medullary rays: that is, from the centre of the stem to the bark, and the other at right angles to this, near the bark. These three cuttings will show the state and position of all the vessels throughout.

ASPHALTE.

Asphalte is a species of pitchy or bituminous stone, which, in ancient times, was much used as a cement in building, and which, of late years, has been recommended to public notice, as excellently adapted for covering floors, roofs, for flagging, and for various other useful purposes.

On examining the valley of Travers, in the Prussian province of Neufchatel, about the year 1712, an ingenious, learned, and speculative Greek, named Eirinis, discovered a fine bed of asphaltic rock, and, probably from some recollections suggested to him by his knowledge of antiquity, began to make experiments upon the value of the rock for *cementing* purposes. He describes this rock, or asphalte, as he called it, to be "composed of a mineral substance, gelatinous and calorous, more clammy and glutinous than pitch; not porous, but very solid, as its weight indicates; and so repelling the influence alike of air, cold, and water, that neither can penetrate it; it is better adapted than any other substance to cement and bind buildings and structures of every kind; preserving the timber from the dry rot, from worms, and the ravages of time; so much so, that exposure to the most inclement extremes of weather only renders it the firmer and the more enduring." Such is the account given by Eirinis of his asphaltic cement; and he also states that its efficacy and durability were tried and proved on many buildings in France, Neufchatel, and Switzerland. "Nothing, (says he) can be easier than the composition of this cement," and he gives directions for melting it as it is taken from the mine, and stirring it when melted, mixing with it at the same time ten per cent. of pitch, after which it is to be spread on the stone or wood to be coated, previously heated to a slight degree.

Such was the first attempt made, in modern times, to turn the natural production, called asphalte, to service in building. Eirinis was not supported properly, however, and the Val de Travers mines, though occasionally wrought by succeeding speculators, have only fallen into competent hands within a very recent period. Count de Sassenay, who had acquired the requisite experience by his having been for six years the proprietor and manager of the Seyssel mines, became, in the beginning of 1838, the proprietor of those of the Valley of Travers, in Neufchatel. The Seyssel mines, it is to be observed, are also asphaltic, and have been wrought for a number of years. But, on examination, Count de Sassenay found the Neufchatel mines to contain a finer-grained rock, and with two per cent. more of bitumen in it than the Seyssel mines. He was therefore led to become the purchaser of the former, and has established a company at Neufchatel, with a capital of forty thousand pounds, for the working of asphalte, and for its sale in the various countries around.

Count de Sassenay states, in the Introduction to a little pamphlet which supplies us with these particulars, that there are two kinds of mineral matter which go by the name of asphalte, though erroneously so. The first is an earthy concretion of gritty, loose texture, to which the Count gives the name of *bituminous molasse*, and which he ascribes to the latest or tertiary formation of rocks. The other substance is the true asphalte, which is solid, of the color of soot, and is an admixture of bitumen with calcareous or limestone rock of the Jura formation, which belongs to the secondary era.

The bitumen is here completely combined or amalgamated with the calcareous material, and this union is productive of a new homogeneous substance, which *alone is the true asphaltic cement,* or asphalte. Bituminous molasse is a mineral substance, comparatively abundant on the continent, and has been wrought in several places with the view of making the same cement, but has not undergone that natural admixture with calcareous matter which constitutes the true asphalte, and hence such views have not been realized. This is not only stated by Count de Sassenay, but by M. Rozet, M. H. Fournel, (a noted engineer,) and other observers. "Many experiments have been made to imitate the cement we have mentioned, (that of Seyssel;) but in these operations the want of the calcareous matter has been attempted to be supplied by substances, which absorbing the bitumen, produce a composition which cannot resist the influence of heat or cold, but is melted by the sun and cracked by the frost." The Val de Travers, where are found the finest kinds, as has been said, of this natural production, formed in all probability under strong volcanic action, leads into the Lake of Neufchâtel. Half-way up the mountain-sides, the asphaltic works are carried on. "The operations," says M. Fournel, "are very simple, and consist merely in blasting the rock. The cavities for the powder are perforated by wimbles of about thirty-nine inches in length, one of which a man can work as he would a carpenter's auger. This manner of boring appears to be applicable only to the asphaltic stone. The labourers can work better in winter than in summer; because the rock being harder and more condensed in cold weather, the powder has more effect, and the blasting is more extensive." The rock is in blocks or irregular masses not in strata, and there is reason to believe that the whole mountain is of asphalte. The manner of preparing the rock for cementing purposes is this. "Ninety-four parts (weight) of the asphaltic stone, pulverised, are mixed with six parts of bitumen, and melted down in large boilers; and the mass is then poured off, and formed into rectangular cakes, which are sold as the asphaltic cement." It is easily re-melted, and instead of losing, gains quality by the repetition of the process. Of late, however, the plan has been adopted of sending the stone itself to the place where it is to be used, and there melting and mixing it with the tar immediately before use. This saves one melting. The way of using it requires little explanation. When melted, the cement is merely spread over the desired part equally, and in such thickness as circumstances may require. In the coating of places to be trodden much, such as footways, terraces, slabs, &c., it is customary to mix fine river sand with it, which gives it more stability, and a degree of roughness that is not unnecessary.

We have now to ask if the asphaltic cement has been extensively tried, and with what issue. Count de Sassenay, when proprietor of the Seyssel mines obtained permision to use the cement in the fortifications of Vincennes, Douay, Grenoble, and Besançon. The Minister of War was satisfied by the experiment that it would be highly advantageous to have the roofs, floors, &c of barrack rooms coated both on the score of cleanliness, (inasmuch as the cementing was easily washed,) and on account of the protection against damp afforded by it. It was also found that rats and mice disappeared where the cement was laid down. On these facts being ascertained, the French Minister of War contracted for the use of asphalte in the various buildings over which he had control. The extensive commissariat magazines at Bercy, and those which supply the garrison of Paris, the roofs, ceilings, and floors of the detached forts at Lyons, the arsenal at Douay, the new barracks at Peronne, those at Mont Louis and other places, were all supplied with asphaltic coatings, in whole or in part. Asphalte was also substituted for the stone pavement in some of the cavalry barracks. The unwearibility of the materials rendered these experiments most satisfactory. [A staircase, coated with the cement by Eirinis more than a hundred years ago, still remains, and is unmarked, whereas contemporary *stone* stairs in the same building are hollowed out by footmarks.] The Ministers of the Marine and of the Interior in France followed the example of the War Minister, and coated their convict-prisons and other edifices with the asphalte, and with equal satisfaction.

These things passed very recently—subsequently, indeed, to the year 1832—when Count de Sassenay became proprietor of the Seyssel mines, from which the asphaltic cement was procured for the purposes mentioned. It was not till 1835 that any experiment was made upon the use of asphalte for flagging thoroughfares. At that time the footway of the Pont Royal was coated with the cement, and its footway by the railings of the Tuilleries, other footways, and the basin of the fountain in Richelieu Street, have been coated with the asphaltic cement, and it has been found to stand equally well the "summer's heat and winter's snow." The Belgians have begun also to use the article extensively in public works. In several parts of London, portions of the street for foot passengers have also been laid with asphaltum, by way of experiment, and it seems to answer all the purpose of flag-stones. Various artificial cements, in imitation of the natural asphaltic, have been brought before the public, but, on trial, they have been found to crack in winter, and to melt in summer—in short, to be totally inefficient in comparison. The asphaltic cement has been used with success in joining stone to stone, or metal to stone. As for its use in the caulking of vessels, we are not aware what has been the result of recent experiments on this point. The induration which forms its chief value in coating pavements and such places, might be injurious in the case of vessels, but an additional proportion of tar to the cement would probably amend this fault and render it useful there also.

CUTTINGS IN WATER,

(Resumed from page 142, and concluded.)

The art of propagating plants by cuttings, embraces a vast number of very interesting facts, some of which will hereafter be noticed as they appropriately occur. The method to which we now solicit the attention of our amateur readers is despised by the professional gardener, as being beneath his skill and attention; nevertheless it will not be difficult to show that the instruction which it conveys is in itself amply sufficient to rescue it from contempt, or rather to raise it high in the estimation of the lover of nature.

The three spring months comprise the period wherein cuttings succeed most freely; and for the reason that they are then inclined to start into

growth, and to obey the increasing stimulus of solar light; but they are not inactive during the summer, and many cuttings of the hard-wooded species prosper most when they are placed in a cool situation late in autumn. They thus retain their vital power during winter, gradually form a callus, or granulated mass, between the bark and wood, and finally develop roots when gently excited by heat in the early spring.

A cutting is prepared by passing a knife either through or close under a joint or leaf; and it almost invariably is found that, if a young shoot be slipped off the parent plant, and carefully trimmed at the heel to remove asperities, and render the surface smooth, roots will be produced much more freely than they would be from any intermediate part; for a number of minute embryo buds exist round the base of a shoot or twig just at the point of its junction with a larger branch. These buds or germs seem peculiarly inclined to protrude root processes, while those seated among the leaves of the upper part tend directly to expand into shoots. But when a cutting is fixed in the soil, whether it be in a spot or in the open ground, its progress is concealed, and can be only conjectured by the appearance of that part which remains above the surface. This forms one objection; another is found in the trouble which attends the plunging in heat, the covering with a hand or bell glass, and the necessity of guarding against mouldiness or damping off, by frequently removing and wiping that glass. A cutting when placed in a phial of water may fail; it may also decay; but, if it is to succeed eventually, two circumstances will become obvious—first, it will not flag or droop, though no glass covering be put on it; and second, the water, however long the cutting remain over it, will show little if any tendency to become fetid or offensive. Every one must have remarked the extreme fœtor acquired by water in which flowers are placed; therefore the contrast exhibited by the fluid in which a vegetating and growing plant remains, during several weeks, exposed perhaps to the occasional heat 95-100 degrees, is equally extraordinary and pleasing; there may be found exceptions; but they have not come under our notice, and we have had not a little experience for many years.

It has long been an observed fact that the oleander (Nerium) will emit roots, if a young green shoot of it be placed in a small bottle of water, exposed either to the sun-heat of a window or to the warm atmosphere of a hot-bed frame or forcing house. It frequently happens that a lively shoot, with the flower-buds becoming visible at its summit, will take root in a few weeks, and being then transferred to a pot of suitable earth, in heat, will retain and expand its flowers, forming a beautiful object in minature.

The succulents root *freely*; so does the balsam. Of the last-named plant, specimens have been produced in a few weeks, with several expanded flowers, although the parent plant did not exhibit the slightest signs of coming into bloom. Some cuttings of the cucumber and melon, taken at the third joint from the summits, or indeed from any part of the plants, rarely fail to root in a few days; and we entertain little doubt that a stock of succession plants for the frames can thus be obtained more readily than by any ordinary process; even single leaves protrude a mass of fibres, though it has not appeared that any latent bud became excited to form a shoot.

Among multitudes of examples we may cite the mints, the French willow, ruellia formosa, all the justicias which were subjected to trial, heliotrope, petunia, &c. as generally free rooters. Dahlia is arbitrary, and so is erythrina crista-galli, or taurifolia; but they succeed after depositing masses of a species of parenchymatous matter. The Gesneraceæ, particularly gloxinia speciosa and candida, rarely fail. The careful observer will perceive in the two last a gradual convexity of form at the base of the cutting; it is the origin of the future tuberous mass, and from it small glittering fibres emerge which appear like glass threads; nothing can exceed the interest possessed by this charming object.

Among shrubs we have tried successfully the common geranium, or pelargonium, the dark China rose, begonia, coronilla, &c.

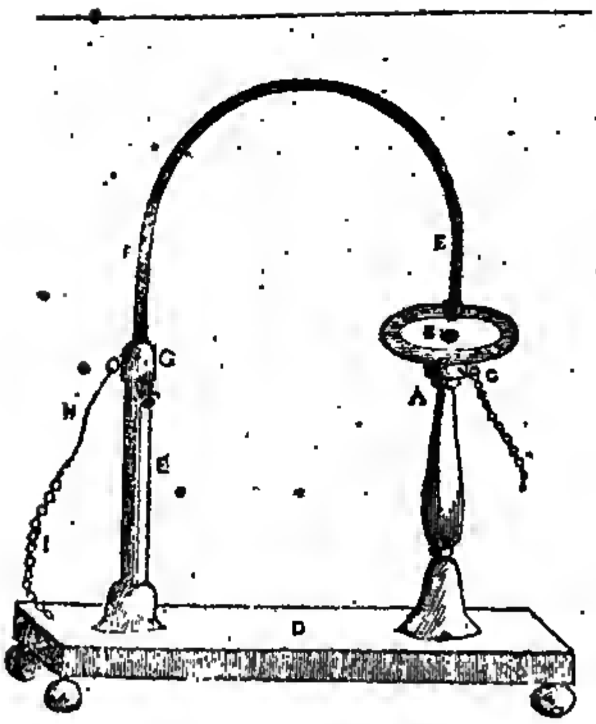
Not to dwell upon the instruction to be derived from the observation of processes which stand revealed to the eye, we do contend that as, in removing these rooted subjects from their fluid element, no injury is done the slightest fibre or most delicate spongeole, a great object is attained; for the plants, if treated with any degree of skill and dexterity, strike off at once, and establish themselves in an appropriate soil with the least possible loss of time.

FIRING GUNPOWDER BY ELECTRICITY.

Until within these few years one of the most difficult, and uncertain experiments in electricity was the firing of gunpowder. A method of accomplishing this with great facility and absolute certainty we owe to Mr. Sturgeon, who is well known to have contributed so largely to the development of electrical science, and the improvement of electrical apparatus.

Formerly it was the practice to pass the shock of a powerful battery through a tube of water, by which means the gunpowder placed between the wires of the universal discharger was sometimes fired, but more often not—if the shock was too powerful the gunpowder was scattered—if the glass tube was too small the gunpowder remained untouched, and the glass tube was exploded—if too large the shock passed through without effect upon any part of the apparatus, as was the case also when a metal wire took the place of the tube of water.

Arguing from these facts, Mr Sturgeon was led to conclude, that the reason why water was at all necessary, was because it retarded the electric fluid until it had time to act upon the combustible, water conducting it with infinite less rapidity then metal—thus water, or some similar imperfect conductor, was necessary. Also the experiments with the large and small glass tubes, proved that the shock, although retarded in its course, must remain concentrated, and, therefore, the smaller the channel of water the greater certainty of success, though, at the same time, the danger of explosion was materially increased. To obviate these difficulties, Mr. Sturgeon thought to substitute for the water tubes, a string or thread, dipped in water. With so much success was this attended, that he was enabled to fire gunpowder at all times, with positive certainty and safety, even when employing a Leyden jar of not more than about a quart capacity. The form of one machine for this purpose may be seen as follows:—



A is a glass rod, supporting a small stand of baked wood. B is a button of metal, let into the stand, and connected with the chain C. E is a glass rod, fitted in a cap, which is fixed to the foot D. G is a cap of metal, fitting on the top of the glass rod E. Screwed into the top of it is the bent wire F F, which is terminated by a little ball situated at about half an inch from B. H is the wetted thread, (a common piece of pack-thread, doubled, about three inches long, will do,) to the end of which is fastened the chain I.

Ex.—Place some dried gunpowder on the metal button B. Wet the thread, and connect one of the chains to the outside of a charged Leyden phial, and the other to the discharging rod—upon passing the shock the gunpowder will be fired.

Ex.—Take away the thread, and put a chain in its place—upon passing the shock the gunpowder will be scattered, but not inflamed.

With a dry thread, or one that is too long, the shock will not pass at all, but with a little previous arrangement the experiment will never fail. It may, also, be fired at any distance, with wires of appropriate length, and even under water, provided only that the connecting wires are covered with a tube of glass, or Indian rubber varnish.

REVIVAL OF THE INSCRIPTIONS ON COINS AND MEDALS.

It has been long known though we have not been able to ascertain to whom we owe the discovery that a coin from which the inscription and the figures have been entirely effaced, so as not to present the slightest trace of an impression, may have the inscription and figure partly or wholly restored by placing it upon a hot iron. In order to perform this experiment with the fullest effect, the coin employed should be one equally worn down, and in which very little of the metal has been worn off the hollow parts by which the letters are surrounded.

When a coin of this kind, or what is still better, a coin on which an illegible trace of the letter still remains, is placed upon a heated iron, it will be seen that an oxidation takes place over its whole surface, the film of oxide changing its tint with the intensity or continuance of the heat. The parts, however, where the letters of the inscription had existed, oxidate at a different rate from the surrounding parts, so that these letters exhibit their shape, and become legible in consequence of the film of oxide which covers them having a different thickness, and therefore reflecting a different tint from that of the parts adjacent. The tints thus developed sometimes pass through many orders of brilliant colors, particularly pink and green, and settle in a bronze, and sometimes a black tint; resting upon the inscription alone. In some cases the tint left on the trace of the letters is so very faint that it can just be seen, and may be easily removed by a slight friction of the finger.

When the experiment is often repeated with the same coin, and the oxidation successively removed after each experiment, the film of oxide continues to diminish, and at last ceases to make its appearance. It recovers the property, however, in the course of time. When the coin is first placed upon the heated iron, and consequently when the oxidation is the greatest, a considerable smoke rises from the coin, and diminishes like the film of oxide by frequent repetition. A coin which has ceased to give out this smoke, smoked lightly after twelve hours exposure to the air, having been removed from the hot iron at the beginning of that interval, and replaced upon it at the end of it by a pair of pincers.

From a great number of experiments, it is found *raised* parts of the coin, and in modern coins, that the elevated ledge round the inscription oxidate first. This ledge, in an English shilling of 1816, began by exhibiting a brilliant yellow tint before it appeared on any other part of the coin.

In examining a number of old coins, a brilliant red globule, accompanied with a smell of sulphur, appeared on one or two points of the coin; and sometimes small globules, like those of quicksilver, exuded from the surface. Other coins exhaled a most intolerable smell; and an Indian pagoda became perfectly black when placed upon the heated iron.

Such being the general facts respecting the oxidation of coins, it becomes an interesting inquiry to determine its cause. If we take a homogeneous and uniform piece of silver, and place it upon a heated iron, its surface will oxidate equally, if all the parts of it are exposed to the same degree of heat. A coin, however, differs from a piece of silver of uniform texture, as it has been struck with great force during the act of coining. In this process the sunk parts have obviously been most compressed by the prominent parts of the die, and the elevated parts least compressed, the metal being left as it were in its natural condition. A coin, therefore, is a piece of metal in which the raised letters and figures have less density than the other parts, and consequently these parts oxidate sooner, or at a lower temperature. When the letters themselves are rubbed off by use, the parts immediately below them have also less density than the metal which surrounds them, and consequently, they receive from heat an oxidation and a color different from that of the surrounding surface. Hence, the reason is obvious, why the invisible letters are revived by oxidation.

A similar effect takes place in the beautiful oxidations which are produced on a surface of polished steel. When the steel has hard portions, called *pins* by the workmen, the uniform tint of the oxide stops near these points, which always display colors different from the rest of the mass.

The smoking of the coin, the diminution of its oxidating power, by a repetition of the experiment, and the recovery of that power by time, seem to indicate that the softer parts of the metal absorb something from the atmosphere which promotes oxidation. Whether this is oxygen or not, remains to be determined.

THE MECHANICAL POWERS.

Mechanical powers are simple arrangements by which we gain power at the expense of time; thus, if a certain weight can be raised to a certain height by unassisted strength, and the same thing is afterwards done with one-tenth part of the exertion, through the use of a mechanic power, it will be found to require ten times as much time. In many cases, however, loss of time is not to be put in competition with the ability to do a thing; and since the advantages which the mechanical powers afford to man, by enabling him to perform feats which, without their assistance, would have been for ever beyond his reach, are incalculably great, the waste of time is overlooked, and is much more than balanced in the general result. It is true that if there are several small weights, manageable by human strength, to be raised to a certain height, it may be full as convenient to elevate them one by one, as to take the advantage of the mechanical powers in raising them all at once; because the same time will be necessary in both cases; but suppose we should have an enormous block of stone or a great tree to raise; bodies of this description cannot be separated into parts proportionable to the human strength, without immense labour nor perhaps without rendering them unfit for those purposes to which they are to be applied; hence then the great importance of the mechanical powers, by the use of which a man is able to manage with ease a weight many times greater than himself.

There are six mechanic powers, viz. the *lever*, *wheel and axle*; the *inclined plane*; the *screw*; the *pulley*; and the *wedge*: out of the whole or a part of which, it will be found that every mechanical engine or piece of machinery is constructed.

The Lever being the simplest of all the mechanic powers, is in general considered the first. It is an inflexible rod or bar of any kind, so disposed as to turn on a pivot or prop, which is always called its *fulcrum*. It has the weight or resistance to be overcome attached to some one part of its length, and the power which is to overcome that resistance applied to another; and, since the *power*, *resistance*, and *fulcrum* admit of various positions with regard to each other, so is the lever divided into three kinds or modifications, distinguished as the first, second, and third kinds of lever. That portion of it which is contained between the fulcrum and the power, is called the acting part or arm of the lever; and that part which is between the fulcrum and resistance, its resisting part or arm.

In the lever of the first kind, the fulcrum is placed between the power and the resistance. A poker, in the act of stirring the fire, well illustrates this subject; the bar is the *fulcrum*, the hand the power, and the coals the resistance to be overcome. Another common application of this kind of lever is the crow-bar, or hand-spike, used for raising a large stone or weight. In all these cases, power is gained in proportion as the distance from the fulcrum to the power, or part where the men apply their strength, is greater than the distance from the fulcrum to that end under the stone or weight. A moment's reflection will show the rationale of this fact; for it is evident that if both the arms of the lever be equal, that is to say, if the fulcrum be midway between the power and weight, no advantage can be gained by it, because they pass over equal spaces in the same time; and, according to the fundamental principle already laid down, *as advantage or power is gained, time must be lost*; but, since no time is lost under such circumstances, there cannot be any power gained. If now, we suppose the fulcrum to be so removed towards the weight, as to make the acting arm of the lever three times the length of the resisting arm, we shall obtain a lever which gains power in the proportion of three to one, that is, a single pound-weight applied at the upper end will balance three pounds suspended at the other. A pair of scissors consist of two levers of this kind, united in one common fulcrum; thus the point at which the two levers are screwed together is the fulcrum; the handles to which the power of the fingers is applied, are the extremities of the acting part of the levers, and the cutting part of the scissors are the resisting parts of the levers; the longer, therefore, the handles, and the shorter the points of the scissors, the more easily you cut with them. A person who has any hard substance to cut, without any knowledge of the theory, diminishes as much as possible the length of the resisting arms, or cutting part of the scissors, by making use of that part of the instrument nearest the screw or rivet. Snuffers are levers of a similar description; so are most kind of pincers, the power of which consists in the resisting arm being very short in comparison with the acting one.

In the lever of the second kind, the resistance or weight is between the fulcrum and the power. Numberless instances of its application daily present themselves to our notice; amongst which may be enumerated the common cutting knife, used by last and pattern makers, one end of which is fixed to the work-bench by a swivel-hook. Two men carrying a load between them, by one or more poles, as a sedan chair, or as brewers carrying a cask of beer, in which case either the back or front man may be considered as the fulcrum, and the other as the power. Every door which turns upon its hinges is a lever of this kind; the hinges may be considered as the fulcrum, or centre of motion, the whole door is the weight to be moved, and the power is applied to that side on which the handle is usually fixed. Nut-crackers, oars, rudders of ships, likewise fall under the same division. The boat is the weight to be moved, the water is the fulcrum, and the waterman at the oar is the power. The masts of ships are also levers of the second kind, for the bottom of the vessel is the fulcrum, the ship the weight, and the wind acting against the sail is the moving power. In this kind of lever the power or advantage is gained in proportion as the distance of the power is greater than the distance of the weight from the fulcrum; if, for instance, the weight hang at one inch from the fulcrum, and the power acts at five inches from it, the power gained is five to one; because in such a case, the power passes over five times as great a space as the weight. It is thus evident why there is considerable difficulty in pushing open a heavy door, if the hand is applied to the part next the hinges, although it may be opened with the greatest ease in the usual method. In the third kind of lever, the fulcrum is

again at one of the extremities, the weight or resistance at the other; and it is now the power which is applied between the fulcrum and resistance. As in this case the weight is farther from the centre of motion than the power, such a lever is never used, except in cases of absolute necessity, as in the case of lifting up a ladder perpendicularly, in order to place it against a wall. The man who raises it cannot place his hands on the upper part of the ladder; the power, therefore, is necessarily placed much nearer the fulcrum than the weight; for the hands are the power, the ground the fulcrum, and the upper part of the ladder the weight. The use of the common fire-tongs is another example, but the circumstance that principally gives this lever importance is, that the limbs of men and animals are actuated by it; for the bones are the levers while the joints are the fulcra, and the muscles which give motion to the limbs, or produce the power, are inserted and act close to the joints, while the action is produced at the extremities; the consequence of such an arrangement is, that although the muscles must necessarily exert an enormous contractile force to produce great action at the extremities, yet a celerity of motion ensues which could not be equally well provided for in any other manner. We adduce one example in illustration of this fact. In lifting a weight with the hand, the lower part of the arm becomes a lever of the third kind; the elbow is the fulcrum; the muscles of the fleshy part of the arm the power; and as these are nearer to the elbow than the hand it is necessary that their power should exceed the weight to be raised. The disadvantage, however, with respect to power, is more than compensated by the convenience resulting from this structure of the arm; and it is no doubt that which is best adapted to enable it to perform its various functions. From these observations it must appear, that although this arrangement must be mentioned as a modification of the lever, it cannot, in strictness, be called a mechanical power; since its resisting arm is in all cases, except one, longer than the acting arm, and that one case is equal to it, on which account it never can gain power, but in most instances must lose it.

(Continued on page 155.)

COPPER IN AMMONIA.

BY J. MACCULLOCH, M.D.F.R.S.F.L.S.

It is an unaccountable omission of chemists, not to have observed that copper is soluble in ammonia; I mean, of course, in the metallic state. This solution takes place rapidly in the heat at which the water of ammonia boils. The water is decomposed during the process, for the purpose of oxidating the metal, and hydrogen is obtained.

This fact may be turned to use in the arts. Gold trinkets, such as chains, are often made of a very inferior alloy; and in this country, I believe, they are never better than eighteen carat gold. They of course require to be colored, to use the jeweller's term. This is done by dissolving the copper of the alloy to a certain depth on the surface; so that, after this operation, the metal is in fact gilded, nothing but pure gold being visible. The coat of pure gold is thus so slight, that it easily wears off in use; so that the operation, of cleaning, (as it is supposed to be by the owners), requires to be frequently performed, and this is done by a fresh process of solution, or coloring.

The method used by the artists is the application of a mixture of neutral salt, intended to disengage nitric acid, with the assistance of heat. In whatever manner, however, this is managed, there is much gold also dissolved in the operation; so much indeed, that where much work of this nature is performed, the quantity of metal rescued from the solutions amounts to a very considerable quantity annually. Artists are accused of doing this with fraudulent views; with what truth I shall not pretend to say. Whatever the fact may be as to this, a few repetitions of the coloring process are sufficient to destroy the finer kinds of workmanship, to the great regret of our ladies.

Boiling in ammonia is a safe substitute for this pernicious process, as it dissolves the copper from the alloy, and leaves in the same manner, a gilded or yellow surface. It has the advantage that it can be performed by any one, without the necessity of employing an artist.

MISCELLANIES.

A Correspondent informs us, that he has found that simple immersion in hot water will effectually fix photogenic drawings, the paper for which has been made by nitrate of silver only, and that this paper is very sensitive.

Different Species of Silkworms.—The silk imported from India is by no means the production of the larva of only one species of moth. MM. Helfer and Hugon have given the following list of the insects, the silk of which is known in commerce.

1. *Bombyx mori.* The common silkworm.

2. *Bombyx religiosæ,* (Helf.) Assam. The cocoon of this phalæna has a finer filament, more gloss, and is softer to the touch than that of the former. The larva lives on the banyan tree, *(Ficus religiosa.)*

3. *Saturnina silhetica,* (Helf.) is found in the mountains near Silhet and Dacca; the cocoons are very large.

4. *Saturnia papia,* (Linn.) The most common of the Indian silkworms. The silk most highly prized in Europe is its produce. In its wild state the larva feeds on the jujube plant. *(Zizyphus jujuba,)* and on the *Terminalia alata,* from which the inhabitants gather the cocoons. It has not been reared in Europe, but M. Helfer found that it could bear domestication well.

5. *Saturnia assamensis,* (Helf.) from Mooga in Assam. Its larva is found on the *Laurus obtusifolia,* and the *Teranthera macrophylla.* This insect produces five generations in the year; the cocoons collected twice during the winter, are the finest and most abundant.

6. *Phalæna cynthia,* (Drury,) a species commonly reared throughout Hindoostan for producing silk: the larva feeds on the *Ricinus,* grows rapidly, and is very hardy; its silk is coarse, but strong, so that a dress made from it lasts for more than a person's life, and such dresses are transmitted from mother to daughter.

It is commonly considered that Indian is inferior to European silk, but this more from the slovenly way the worms are reared in the East than from any inferiority in the staple. Attention is now much attracted to the subject in India, and ere long this produce will most probably rival in quality that from Italy.

Action of Water on Melted Glass.—Mr. Parkes, in his Essays, has adverted to some appearances produced by water flung upon glass when in the furnace, which appear extremely strange, although they were related to him by the most undisputed authorities.

If a small quantity, even a pint of water, were to be thrown into a crucible of glass in a melted, or rather melting state, while the scum or sandiver is upon its surface, the water would be converted instantly into steam, so that an explosion would take place; and if the quantity of water were more considerable, the furnace would probably be blown down.

But when the sandiver has been scummed off, and the glass in quiet fusion, if water is thrown on it, the globules dance upon the surface of the melted glass for a considerable time, like so many globules of quicksilver upon a drum head, while the drummer is beating it.

There is, however, a similar appearance to this that takes place in iron; for water evaporates sooner from a plate of iron that is heated to redness only, than from a plate that has been brought to a welding heat, or very nearly to the heat necessary to melt it.

But in the manufacture of black bottles, it frequently happens, that while the workmen are employed in moulding and blowing the bottles, that the glass, or metal as it is called, becomes too cold to work, so that they find it necessary to desire the firemen to throw in cold and increase the heat.

This, however carefully it may be done, will sometimes produce so much dust that the surface of glass becomes covered with coal dust. When this accident occurs, it occasions such a motion within the melting pot, that the glass appears as if it were actually boiling; and if the metal was used in this state, every bottle would be speckled throughout and full of air bubbles.

Now, as it would be very inconvenient to wait for the whole of this coaly dust to be consumed by the fire, and, besides, it might occasion the glass to boil over the edges of the melting pot, the workmen have to endeavour to discover an easy and effectual remedy for this accident; and this remedy is no other than common water.

Whenever this circumstance takes place, the workmen throw a little water into each of the melting pots. This water has the effect, not only of stilling the boiling of the glass immediately, but it also renders the metal as smooth and pure as before.

Mr. Parkes considers this curious and almost instantaneous effect, as probably owing to the water becoming decomposed, and affording its oxygen to the coal dust, and thus converting it into carbonic acid gas, which immediately escapes and is dissipated in the atmosphere.

Simple Remedy to Purify Water.—It is not so generally know as it ought to be, that pounded alum possesses the property of purifying water. A large table-spoonful of pulverized alum, sprinkled into a hogshead of water, (the water stirred round at the time,) will, after a lapse of a few hours, by precipitating to the bottom the impure particles, so purify it that it will be found to possess nearly all the freshness and clearness of the finest spring water. A pailful, containing four gallons, may be purified by a single tea-spoonful.

Carbonate of Potash from Green and Dry Plants.—M. Becquerel has made some experiments on the manufacture of potash. The comparative analysis of a great number of ashes have proved that those of green wood yield a much greater proportion of saline matter than dry wood. This difference is especially striking with the ashes of fern the ley of the ashes contains a mixture of subcarbonate and sulphate of potash; the proportion of the former varies from 0·45 to 0·65; it is this variation which causes the great difference of quality and price in potash of commerce; It becomes, therefore, very important, in the manufacture of potash, to separate the sulphate with which the subcarbonate is mixed. M. Becquerel effected this by concentrating the solution to spec. grav. about 1·4, and allowing it to cool: the greater part of the sulphate of potash crystallizes on cooling, and the saline matter which remains in solution contains afterwards 0·90 of subcarbonate. M. Becquerel has also ascertained, by his numerous analysis of different kinds of ashes, that those of the lime-burner contain very little sulphate of potash, which is undoubtedly due to the action of the lime upon the sulphate of potash, with the assistance of charcoal. This fact, M. Becquerel remarks, may lead to some advantage, by adding lime to the wood, the ashes of which are intended for the manufacture of potash.

Filtering Machine.—Take a large flower-pot, and put either a piece of sponge or some cleanly washed moss (Sphagnum is to be preferred) over the hole at the bottom. Fill the pot ¾ full with a mixture of equal parts of clean sharp sand and charcoal broken into pieces about the size of peas. On this lay a piece of linen or woollen cloth, large enough to hang over the sides of the pot. Pour the water to be filtered into the basin formed by the cloth, and it will come out pure through the sponge in the bottom. The cloth must be frequently taken out and washed, as must the sand and charcoal, and the piece of sponge or moss in the bottom. The larger the pot, the more complete will be the filtration. The charcoal is easily procured, by burning a few pieces of wood in a slow fire. This is the cheapest description of filter which we know of.—*Gardener's Mag.*

QUERIES.

109—What is Kyan's anti dry rot composition? *Answered in page* 156.

110—What is the best receipt for permanent ink for writing on linen without preparation? *Answered in page* 207.

111—How is the Koniophostic light, as shown at the Surrey Zoological Gardens, produced? *Answered in page* 168.

112—What points of comparative difference are there between common and voltaic electricity? *Answered in page* 160.

113—How are glass seals, bread seals, and gum seals made? *Answered in page* 181.

114—If you place a pail of water in a fresh-painted room a film of oil will come on the surface. What is the reason of it? *Answered in page* 207.

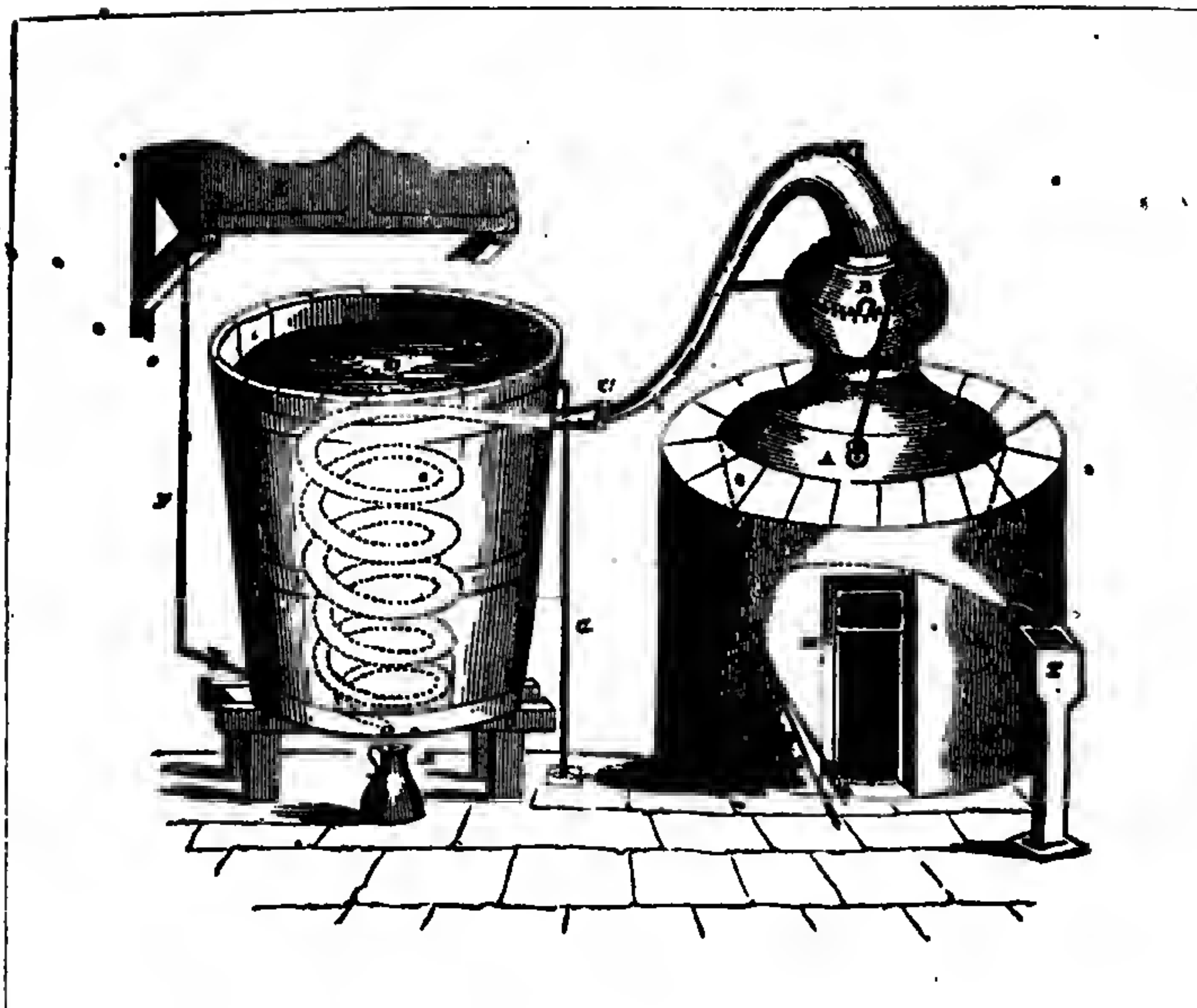
115—How are the colored flames of rocket stars, and other fire works, produced? *Answered in pages* 256 *and* 328.

116—When an effervescing draught is mixed in a tumbler, and stirred with a spoon or glass rod, thus striking the edge of the glass emits a different sound as the effervescence proceeds. Why is this? *Answered in page* 207.

117—How are straw hats whitened? *Answered in page* 160.

118—How is bees' wax bleached? *Answered in page* 160.

119—How are essential oils distilled? *Answered in page* 359.



THE STILL.

DISTILLATION.

The term distillation is understood to signify the process of purifying liquids by boiling, or first converting them into steam, and condensing that steam afterwards—by which means those impurities, which are not of a volatile nature, are retained in *the still*, or vessel in which the boiling is carried on, while the steam itself contains the more ethereal particles of the original mass.

In its application to the purposes of life, distillation is of the utmost importance and extent, and would naturally be divided into various sections, according to the nature of the product required. Thus the distillation of ardent spirits—of acids—of essential oils—and of bituminous substances, as in the manufacture of tar, coal gas, &c., are processes, similar in principle, and in the apparatus employed, however much they may vary in detail and manipulation.

In considering this process it is first necessary to describe *The Still*, or, as it was once called, *The Alembic*. A is the body of the still; it is shaped, set in brick-work, and furnished with a fire-place, in the same manner as a common brewing copper, except that it is contracted at the top into a narrow orifice, only sufficient for a man to creep in should such be requisite. B is the head, which fits closely over the upper part of A—the head is continued without an open joint till it arrives at C, which is the mouth of the worm, or condenser. The worm proceeds in a spiral form from the top to the bottom of the worm tub D—here it passes through the wood of the tub, ending in a short piece, called the nose. E is a can to receive the condensed steam, which during the process passes from the worm. F is a pipe, connected with the cistern K, to keep the worm tub supplied with cold water. G is another pipe, fastened to the upper part of the tub, and carried through the floor to take off the warm or waste water. H is the fire-place. I a trunk or shoot, to carry away the impure liquid remaining in the still after the spirit is extracted from it. J is the coal-hole. K the water cistern, which may be at any convenient distance or situation.

The process is as follows:—The liquid, for example beer, is put into the vessel A, until about two-thirds full. The head B is put on so as to unite well with the body, and also with the mouth

of the worm C. The joints are now *luted*, that is, filled up well with the following

CEMENT, OR LUTE.

1 lb. of whitening.
1 lb. of flour.
½ lb. of salt—and
Water to make it into a stiff dough.

This is the composition used by all the spirit distillers. It is hard, not liable to crack or peel off, and is the better for keeping. The apparatus is now prepared for working. The fire is urged, until the contents of A nearly boil, which is known by a few drops passing from the worm. Great care is now requisite lest the still should boil over, or as it is technically called, should *run foul*. The fire being watched, the still will gradually become in a boiling state, and the steam pass more rapidly into the worm, and consequently the condensed spirit come more rapidly from the nose of it into the can placed beneath. The distiller now damps the fire somewhat, and opens the cock seen in the lower end of the pipe F, thus supplying the worm tub with cold water. This when first admitted plays against the bottom of the worm, cooling as much as possible the spirit as it passes out—becoming itself proportionably heated. Its specific gravity being thereby lessened it ascends, cooling the worm in its progress upwards—for it will be remarked, that the cooling of the worm, and consequent heating of the water in contact with it, is gradually progressive; and as the spirit within is cold only when about to run away, so the water arrives at its full heat when at the top of the worm tub. In this heated state, the water being no longer useful for condensation, it passes off by the pipe G. The duty levied upon spirituous liquors is so great—the quantity consumed so enormous—and the facilities of the manufacture, and after disposal of them so great, that the excise regulations relative to distillation are necessarily numerous and vexations. Thus no person is allowed to use a still of a capacity greater than seven quarts, without giving notice and registering the same; if to be used only for the extracting of essential oils, acids, ammonia, or other product, not to be used afterwards as a drinkable article, a few cautionary regulations are all that the owner will be subjected to: but the utmost severity of inspection attends the rectifier, and malt distiller, to prevent infringement of the law, and to protect the revenue. For example, the rectifier must have one still, at least of 120 gallons—give notice when he is about to work—when not at work, the head of the still is locked by a staple, or chain, passing over it to a beam above, and the fire-place door is also kept fastened up by the exciseman. The distiller charges the still when he pleases, and sends a notice in writing six hours previously, to inform the officer that he is about to work at a certain hour the next morning. The exciseman comes — measures the contents—locks down the head with an iron bar across it, as represented in the plate—unlocks the fire-place, and fastens up the discharging cock at the bottom of the still. In the evening, when the whole operation is done, the head, and fire-place are fastened up as at first.

The first proceeds, or the spirit which runs immediately after the boiling commences, is very strong, and remains so for some considerable time—it then gradually becomes weaker and weaker, until at last it contains but little spirit, and that contaminated with some of the impurities of the residue in the still. This weak impure spirit is called *feints*, and is set aside for re-distillation. When the whole spirit is extracted, the liquid remaining in the still is called *spent wash*, and is either given to pigs and cows, or started from the drains as useless.

The circumstances which most engage the attention of the distiller are, first, to look occasionally at the luting, and to repair it in case of a leakage. Secondly, to know when the still is about to boil. This he ascertains in a curious manner: viz. by putting a drop of candle grease upon the ball of the head, and others at regular intervals of about one foot each upwards, and along the neck. When that drop at the top bend of the neck melts, the steam is passing over, and the fire is carefully watched—when all of the spots are melted, the still boils. Thirdly, his care is to obtain the spirit *quite cold*, the supply of water being regulated so as to bring the spirit to a temperature of not greater than 60° Fahrenheit; and fourthly, to waste no spirit by stopping the process too soon; this is ascertained by throwing a spoonful of the feints then passing into the fire; if it suddenly inflames it is known still to contain spirit. This, however, though the usual practice, is not a criterion, because common water thrown upon a hot fire will, by being instantly decomposed, flame in like manner. The better practice is to throw a little on the head of the still; this being hot, changes the liquid thrown upon it into vapour—if this catches fire, upon the application of a candle, it is known to be worth preserving.

(Continued on page 206.)

THE OXIDATION OF COPPER-PLATES.

The oxidation of copper-plates is a matter of very great importance in the arts; nor are the printers aware of the injury which these sustain in consequence of it. It is usual, in all great and expensive works, not to print more impressions at once than are required for the present demand, when the plates are laid aside till they are again wanted. Thus they are often kept for many years; while, after each operation, they acquire an iridescent oxidated surface, which is removed by the hand of the operator in the first inking. A scale is thus repeatedly removed from the plate, to the great injury of all the finer lines—producing bad impressions, and, together with ordinary injury from the hand and the chalk, at length rendering it what is technically called rotten and useless.

The mere operation of inking must, in time, wear out any plate, even in the most careful hands; but this evil would be diminished by preventing the oxidation in question; which, in some cases, produces a far thicker crust than would be imagined, and as, in itself, sufficient to be a cause of very serious injury to the distances and fainter parts.

This evil might be diminished by printing more impressions at one time: but, where it is necessary to lay the plate aside, it might be entirely prevented by varnishing. For this purpose, common lac varnish is easily applied; and it can be removed, when requisite, by spirits of wine. The varnish of caoutchouc might also be used for the same purpose.

THE MECHANICAL POWERS.

(Resumed from page 151, and concluded.)

The Wheel and Axle is the next mechanical power to be considered; it must be known to every reader who has seen a village well; for it is by this power that the bucket is drawn up, although in such cases, instead of a wheel attached to the axle, there is generally only a crooked handle, which answers the purpose of winding the rope round the axle, and thus raising the bucket. It is evident, however, that this crooked handle is equivalent to a wheel; for the handle describes a circle as it revolves, while the straight piece which is united to the axle corresponds with the spoke of a wheel. This power may be resolved into a lever; in fact, what is it but a lever moving round an axle? and always retaining the effect gained during every part of the motion, by means of a rope wound round the butt end of the axle: the spoke of the wheel being the long arm of the lever, and the half diameter of the axle its short arm. The axle is not in itself a mechanical power, for it is as impotent as a lever, whose fulcrum is in the centre; but add to it the wheel, and we have a power which will increase in proportion as the circumference of the wheel exceeds that of the axle. This arises from the velocity of the circumference being so much greater than that of the axle, as it is further from the centre of motion; for the wheel describes a great circle in the same space of time that the axle describes a small one; therefore the power is increased in the same proportion as the circumference of the wheel is greater than that of the axle. Those who have ever drawn a bucket from a well by this machine, must have observed, that as the bucket ascended nearer the top the difficulty increased: such an effect must necessarily follow from the views we have just offered; for whenever the rope coils more than once the length of the axle, the difference between its circumference and that of the wheel is necessarily diminished. To the principle of the wheel and axle may be referred the capstan, windlass, and all those numerous kinds of cranes which are to be seen at the different wharfs on the banks of the river Thames. It is scarcely necessary to add, that the force of the windmill depends upon a similar power. The *tread-mill* furnishes another striking example. The wheel and axle is sometimes used to multiply motion, instead of to gain power, as in the multiplying wheel of the common jack, to which it is applied when the weight cannot conveniently have a long line of descent; a heavy weight is in this case made to act upon the axle, while the wheel, by its greatest circumference, winds up a much longer quantity of line than the simple descent of the weight could require, and thus the machine is made to go much longer without winding than it otherwise would do.

The Pulley is a power of very extensive application. Every one must have seen a pulley; it is a circular and flat piece of wood or metal, with a string which runs in a groove round it. Where, however, this is fixed, it cannot afford any power to raise a weight; for it is evident, that, in order to raise it, the power must be greater than the weight and that if the rope be pulled down one inch, the weight will only ascend the same space; consequently, there cannot be any mechanical advantage from the arrangement. This, however, is not the case where the pulley is not fixed. Suppose one end of the rope be fastened to a hook in the ceiling and that to the moveable pulley on the rope a cask be attached, is it not evident that the hand applied to the other extremity of the rope will sustain it more easily than if it held the cask suspended to a cord without a pulley? Experience shows that this is the fact, and theory explains it by suggesting that the fixed hook sustains half the weight, and that the hand, therefore, has only the other half to sustain. The hook will also afford the same assistance in raising the weight as in sustaining it; if the hand has but one half the weight to sustain, it will also have only one half the weight to raise; but observe, that in raising the weight, the velocity of the hand must be double that of the cask; for in order to raise the weight one inch, the hand must draw each of the strings one inch; the whole string is therefore shortened two inches, while the weight is raised only one. Pulleys then act on the same principle as the lever, the deficiency of strength of the power being compensated by its superior velocity. It will follow, from these premises, that the greater the number of pulleys connected by a string the more easily the weight is raised, as the difficulty is divided amongst the number of strings, or rather of parts into which the string is divided by the pulleys. Several pulleys, thus connected, form what is called a system, or tackle of pulleys. They may have been seen suspended from cranes, to raise goods into warehouses, and in ships to draw up the sails.

The Inclined Plane is a mechanic power which is seldom used in the construction of machinery, but applies more particularly to the moving or raising of loads upon slopes or hills, as in rolling a cask up or down a sloping plank into or out of a cart or cellar, or drawing a carriage up a sloping road or hill, all which operations are performed with less exertion than would be required if the same load were lifted perpendicularly. It is a power which cannot be resolved into that of the lever; it is a distinct principle, and those writers who have attempted to simplify the mechanical powers, have been obliged to acknowledge the inclined plane as elementary. The method of estimating the advantage gained by this mechanical power is very easy; for just as much as the length of the plane exceeds its perpendicular height, so much is the advantage gained; if, for instance, its length be three times greater than its height, a weight could be drawn to its summit with a third part of the strength required for lifting it up at the end; but, in accordance with the principle so frequently alluded to, such a power will be at the expense of time, for there will be three times more space to pass over. The reason why horses are eased by taking a zigzag direction, in ascending or descending a steep hill, will appear from the preceding account of the action of the inclined plane, because in this way the effective length of the inclining surface is increased while its height remains the same.

The Wedge is rather a compound, than a distinct mechanical power; since it is composed of two inclined planes, and in action frequently performs the functions of a lever. It is sometimes employed in raising bodies, thus the largest ship may be raised to a small height by driving a wedge below it; but its more common application is that of dividing and cleaving bodies. As an elevator, it resembles exactly the inclined plane; for the action is obviously the very same, whether the wedge be pushed under the load, or the load be drawn over the wedge. But when the wedge is drawn forward, the percussive

tremor excited destroys, for an instant, the adhesion or friction at its sides, and augments prodigiously the effect. From this principle chiefly is derived the power of the wedge in rending wood and other substances. It then acts besides as a lever, insinuating itself into the cleft as fast as the parts are opened by the vibrating concussion. To bring the action of the wedge, therefore, under a strict calculation, would be extremely difficult, if not impossible. Its effects are chiefly discovered by experience. All the various kinds of cutting tools, such as axes, knives, chisels, saws, planes, and files are only different modifications of the wedge.

The Screw is a most efficient mechanic power, and is of great force and general application. It is in reality nothing more than an inclined plane formed round a cylinder, instead of being a continued straight line. Its power is, therefore, estimated by taking its circumference, and dividing this by the distance between any two of its threads; for what is taking the circumference of a screw, but another mode of measuring the length of the inclined plane which wraps round it? and taking the distance between one thread and the next to it, is but measuring the rise of that inclined plane in such length; and from the properties of the inclined plane, it follows, that the closer the threads of a screw are together in proportion to its diameter, the greater will be the power gained by it.

ANTI-DRY ROT.

The dry rot is a plant called by botanists *merulius lachrymans*, which is, alas, too common on the inside of wainscottings, where there is not a free circulation of air, in the hollow trunks of trees, beams, ship timber, &c. It first appears like a soft, very light, cottony mass, of a white color; afterwards it throws out yellow or orange-colored veins, which at last become reddish brown, and distil as it were drops of water, filled with minute ferruginous sporules or seeds, which, by the liquid, are conveyed to other parts of the trunk; and thus the dreadful contagion is propagated far and wide, and the original timber broken up into perfect dust, its destruction being occasioned not merely by the growth of the plant itself, but accelerated by the moisture thus introduced.

The principle upon which all anti-dry rot preparations must be formed is, that vegetable life should be destroyed, and yet that the woody fibre should not be injured—and to fulfil both these conditions nothing but a solution of corrosive sublimate is found to answer, and this in proportion to the degree of perfection with which the various bodies are saturated by the drug; thus for cordage, canvas, and wood under certain circumstances, it is sufficient, but it has yet to be proved how far it may be efficacious for large beams of timber, as this must depend upon the fact of penetration.

The following remarks are extracted from the evidence taken before the Commissioners appointed to examine into the efficacy of Mr. Kyan's process.

"All the persons examined, who have used the prepared wood, are of opinion that the process renders the ordinary length of time for seasoning timber unnecessary. Sir Robert Smirke, however, thinks that while timber of large scoutling may be used the sooner for it, still it would not supersede the usual length of time for seasoning wood for joiners' work."

As to the strength of the solution, with a view to the expense, there has been great inconsistency in the statements made to the Commissioners. The solution for the experiment at Somerset House, consisted of 224 pounds corrosive sublimate to 1,062 gallons of water, being rather more then 1 pound of corrosive sublimate to 5 gallons of water, (the proportion last named by Mr. Kyan,) the price of the corrosive sublimate at the time of this experiment being 3*s*. 7*d*. per pound. It was stated by Mr. Kyan that the solution loses none of its strength, and becomes in no way altered by the immersion of the timber; and the greater part of the solution in the tank, at the time of the Commissioners' visit to Mr. Kyan's premises, was stated to have been in use some years.

"Two bottles of the solution used for the experiment at Somerset House were sent to Professor Faraday, one having been filled before the immersion of the timber, and the other afterwards; and he has stated that they contain the same proportions of corrosive sublimate in solution.

"On the point of expense, it may be proper to observe that the additional cost of building the Samuel Enderbey, a ship 420 tons, entirely of the prepared timber, was 240*l*.; and it appears that the Board of Admiralty have agreed to pay at the rate of 15*s*. a load extra for such as may be used in the construction of the Linnet.

"As to the salubrity of the process, the evidence proves it to have produced no ill effect upon the health of the workmen, who have used the prepared timber for ship building or other purposes. It, however, appears that great caution is requisite in preparing the solution, and in the use of the process.

"With regard to its effects on the health of ships' crew, the Commissioners observe that the Samuel Enderbey, which was completely built with prepared timber last year, sailed last October for the South Seas; and in three accounts received from apprentices on board her, (none others have come to hand) one of which was dated lat. 3° S., long. 24° 30 W., the crew was mentioned as being all well. Another ship, the John Palmer, was extensively repaired in the autumn of 1833 with new timbers and new topsides from the light-water mark; the interior was also new from the lower deck upwards; and the whole of the timber used for these works, as also the plank used for the men's fitted sleeping berths, were prepared on Mr. Kyan's plan. Two accounts received from the master since she sailed, one dated on the Line, and the other from the Straits of Timor, state that the crew were all well.

"The Commissioners consider it desirable to avoid any risk, by placing provisions in direct contact with the prepared wood; and they suggest that ropes and sails being much handled by seamen, the raw material of them when prepared, should be washed, prior to being manufactured.

"As to the alleged increased purity of bilge water in ships built of the prepared timber, some that was pumped out of the Samuel Enderbey last autumn, 'was perfectly sweet.'"

THE INDIAN BLOW-PIPE.

When a native of Macoushi goes in quest of feathered or other game, he seldom carries his bow and arrows. It is the *blow-pipe* he then uses. This extraordinary tube of death, is, perhaps, one of the greatest natural curiosities in Guiana. It is not found in the country of Macoushi. Those Indians tell you that it grows to the south-west of them in the wilds which extend betwixt them and

the Rio Negro. The reed must grow to an amazing length, as the part the Indians use is from ten to eleven feet long, and no tapering can be perceived in it, one end being as thick as the other. It is of a bright yellow color, perfectly smooth both inside and out. It grows hollow; nor is there the least appearance of a knot throughout the whole extent. The natives call it *ourah*. This of itself, is too slender to answer the end of a blow-pipe; but there is a species of palm, larger and stronger, and common in Guiana, and this the Indians make use of as a case, in which they put the *ourah*. It is brown, susceptible of a fine polish, and appears as if it had joints five or six inches from each other. It is called *samourah*,* and the pulp inside is easily extracted, by steeping it for a few days in water. Thus the ourah and samourah, one within the other, form the blow-pipe of Guiana. The end which is applied to the mouth is tied round with a small silk-grass cord, to prevent its splitting; and the other end, which is apt to strike against the ground, is secured by the seed of the acuero fruit, cut horizontally through the middle, with a hole made in the end, through which is put the extremity of the blow-pipe. It is fastened on with string on the outside, and the inside is filled up with wild bees' wax. The arrow is from nine to ten inches long. It is made out of the leaf of a species of palm-tree, called *coucourite*, hard and brittle, and pointed as sharp as a needle. About an inch of the pointed end is poisoned with the *wourali*. The other end is burnt, to make it still harder, and wild cotton is put round it for about an inch and a half. It requires considerable practice to put on this cotton well. It must just be large enough to fit the hollow of the tube, and taper off to nothing downwards. They tie it on with a thread of the silk grass, to prevent its slipping off the arrow.

With a quiver of poisoned arrows slung over his shoulder, and with his blow-pipe in his hand, in the same position as a soldier carries his musket, the Macoushi Indian advances towards the forest in quest of powises, maroudis, waracabas, and other feathered game.

These generally sit high up in the tall and tufted trees, but still are not out of the Indian's reach; for his blow-pipe, at its greatest elevation, will send an arrow 300 feet. Silent as midnight he steals under them, and so cautiously does he tread the ground that the fallen leaves rustle not beneath his feet. His ears are open to the least sound, while his eye, keen as that of the lynx, is employed in finding out the game in the thickest shade. Often he imitates their cry, and decoys them from tree to tree, till they are within reach of his tube. Then taking a poisoned arrow from his quiver he puts it in the blow-pipe, and collects his breath for the fatal puff. About two feet from the end through which he blows, there are fastened two teeth of the acouri, and these serve him for a sight. Silent and swift the arrow flies, and seldom fails to pierce the object at which it is sent. Sometimes the wounded bird remains in the same tree where it was shot, and in three minutes falls down at the Indian's feet. Should he take wing, his flight is of short duration, and the Indian, following the direction he has gone, is sure to find him dead. It is natural to imagine that, when a slight wound only is inflicted, the game will make its escape. Far otherwise; the woorali poison almost instantaneously mixes with blood or water, so that if you wet your finger, and dash it along the poisoned arrow in the quickest manner possible, you are sure to carry off some of the poison. Though three minutes generally elapse before the convulsions come on in the wounded bird still a stupor evidently takes place sooner, and this stupor manifests itself by an apparent unwillingness in the bird to move.

The Indian, on his return home, carefully suspends his blow-pipe from the top of his spiral roof, seldom placing it in an oblique position, lest it should receive a cast.

DRAINING LAND BY STEAM POWER.

The draining of land by steam power has been extensively adopted in the fens of Lincolnshire, Cambridgeshire, and Bedfordshire, and with immense advantage. A steam engine of 10-horse power has been found sufficient to drain a district comprising 1,000 acres of land, and the water can always be kept down to any given distance below the plants. If rain fall in excess, the water is thrown off by the engine; if the weather is dry, the sluices can be opened, and water let in from the river. The engines are required to work four months out of the twelve, at intervals varying with the season, where the districts are large; the expense of drainage by steam power is about 2*s.* 6d. per acre. The first cost of the work varies with the different nature of the substrata, but generally it amounts to 20*s.* per acre for the machinery and buildings. An engine of 40-horse power, and scoop-wheel for draining, and requisite buildings, costs about £4,000, and is capable of draining 4,000 acres of land. In many places in the fens, land has been purchased at from £10 to £20 per acre, which has been so much improved by drainage as to be worth £60 or £70 per acre. The following list shows the number of steam-engines employed for this purpose in England:—Deeping Fen, near Spalding, Lincolnshire, containing 25,000 acres, is drained by two engines of 80 and 60-horse power. March West Fen, in Cambridgeshire, containing 3,600 acres, by one engine of 40-horse power. Misserton Moss, with Everton and Graingley Cars, containing about 6,000 acres, effectually drained by one engine of 40-horse power Littleport Fen, near Ely, about 28,000 acres, drained by two steam engines of 30 or 40-horse power each. Before steam was used there were 75 wind-engines in this district, a few of which are still retained. Middle Fen, near Soham, Cambridgeshire, containing 7,000 acres, drained by an engine of 60-horse power. Water-Beach Level, between Ely and Cambridgeshire, containing 5,600 acres, by a steam engine of 60-horse power. Magdalen Fen, near Lynn, in Norfolk, contains upwards of 4,000 acres, and is completely drained by a steam engine of 40-horse power. March Fen district, Cambridgeshire, of 2,700 acres, is kept in the finest possible state of drainage by a 30-horse power engine. Feltwell Fen, near Brandon, 2,400 acres, by an engine of 20-horse power. Soham Mere, Cambridgeshire, formerly, as its name implies, a lake, of 1,600 acres drained by a 40-horse power engine—the lift at this place being very considerable.

ARTESIAN WELLS.

This is the term bestowed on springs of water, formed by perforating the earth with boring-rods, until a subterranean body of water be reached, whose sources are higher than the spot where the operation takes place. The effort which water makes to reach its own level causes it to ascend above the surface, and thus a supply of this ne-

cessary element is often obtained in districts otherwise destitute. The term is derived from *Artois* a province of France, where water is chiefly obtained by boring.

The question as to whence Artesian wells derive their supplies is one of the most interesting connected with the subject. The vapours of the atmosphere form one of their sources. A few hours after heavy rains, the miners of Cornwall observe a considerable augmentation in the water contained in some of their deepest pits. The fountain of Nismes, in France, throws out, when lowest, about 280 gallons per minute; but if heavy rain falls in the north-west, although at a distance of seven or eight miles, its volume is increased to upwards of 2000 gallons. The temperature, however, is scarcely changed by this great additional quantity; thus proving that it passes with great rapidity by channels situated very deeply below the surface.

The fountain of Vaucluse, likewise in the south of France, if it received all the rain which fell during the whole year, on an extent of thirty square leagues, would not obtain a supply adequate to the yearly issue which it pours forth. When it rises from its subterranean bed, it in reality forms a river; and the volume of its waters when at its lowest is estimated at 480 square yards per minute, which at times is swelled to 1494 square yards. Its mean volume in 962 square yards. This fountain, it is clear, most obtain its waters from some more abundant source than the percolation of rain water through the pores and fissures of the earth. Its reservoirs, also, must be capable of containing a great mass of fluid, and the channels by which it flows must be large enough to contain a subterranean river.

These reservoirs and these channels are created by fractures in great areas of stratified rock, occasioned by the action of a mighty power, which, at some period, has broken them in various directions. In some cases, these cavities actually withdraw from the surface considerable rivers. The Guadiana loses itself in a flat country, in the midst of a vast prairie; and when a Spaniard hears an Englishman or a Frenchman speaking of the bridges of their respective countries, he will tell them that their is one in Estremadura on which 100,000 cattle can graze. The Meuse and several other rivers in France also disappear in the same manner; some being sucked in by apertures in their bed, situated at various distances along the course of the stream. In the Austrian dominions, the river Poick pursues its course in the cavern of Adelsberg, where its waters lose themselves and re-appear several times. This cavern has been penetrated for the space of two leagues from its entrance, at which point a lake presents itself which has not yet been crossed, Humboldt mentions a cavern in South America, about twenty-five yards high and twenty-seven or twenty-eight broad, which the traveller can penetrate for 800 yards, into whose recesses are rolled the waters of a stream above ten yards wide. The grotto of Windborg, in Saxony, is also a remarkable instance of the extent of the earth's internal communications, being connected with the cavern of Cresfield, from which it is some leagues distant.

The Artesian fountain at Tours recently presented some phenomena proving the existence of an extensive and complete line of subterranean communication. In January, 1831, the vertical tube by which the waters of this fountain ascended was shortened a little more than four yards, on which its volume was immediately augmented a third; but this sudden increase rendered the water less clear than usual. During many hours there were brought to the surface, from a depth of above 110 yards, various substances, among which were recognised twigs of hawthorn, several inches in length, blackened by their long stay in the water—stalks and roots of marshy plants—and seeds of various kinds, in a state which showed that they had been in the water since the harvest, and, consequently, that about four months had been spent in performing their hidden voyage. Shells, and other deposits which a small river, or stream of fresh water, leaves when it overflows its banks, were also brought up during the increased action of the fountain, proving the freedom with which they circulated at the depths below.

An instance is mentioned by M. Arago in the 'Annnaire,' for 1835, of one of these subterranean rivers being reached by some workmen who were boring for water close to the Barrière de Fontainebleau, at Paris. As usual, the progress of the work was slow, but, all at once, the boring-rod descended nearly eight yards. When they attempted to withdraw it, it was evident that it was suspended in a body of water whose current was so strong as to occasion the instrument to oscillate in a particular direction.

The temperature of Artesian springs is invariably higher in proportion as their depth increases. The deepest of which we have seen any statement is near Dieppe, and is about 340 yards below the surface. A well formed near Perpignan produces about 425 gallons per minute; and one at Tours ascends more than two yards above the surface, and gives 342 gallons per minute.

In France, the waters of Artesian springs are sometimes made the moving power in corn-mills. At Frontès, near Aire, the waters of ten Artesian springs put in motion the wheels of a large mill, and act besides upon the bellows and forge hammer of a nail manufactory. At Tours, a well of nearly 150 yards in depth pours 225 gallons per minute into the troughs of a wheel seven yards in diameter, which is the moving power of an extensive silk manufactory. Besides their general utility in irrigations, and for purposes of domestic comfort and salubrity, the water of Artesian springs has been specially applied with advantage for other useful objects. The workshops of M. Buckmarm, in Wurtemburg, are warmed by means of water conveyed in pipes from an Artesian spring, the temperature of whose source is considerably higher than that of the atmosphere. M. Arago also states that there are green-houses whose temperature is kept up by means of the circulation of a constant volume of Artesian waters. At Erfurt they are used in the formation of artificial beds of cress, which produce £12,000 a-year. In the north of France, the reservoirs in which the flax is steeped which is destined to be employed in the manufacture of lace and the finer descriptions of linen, are supplied by Artesian springs, whose waters, being remarkably clear and of equable temperature, dissolve the vegetable matter with the least injury to the most valuable properties of the plant. In fish-preserves it is often found that the fish are killed both by the severity of the winter and the excessive heats of summer; but this effect of the inequality of the seasons has been prevented at the fish-ponds of of Montmorency, near Paris, by furnishing them abundantly with Artesian waters.

CASTS OF LEAVES OF PLANTS.

Very accurate casts of leaves of plants may be prepared by a very simple process. A quantity of fine grained sand, in rather a moist state, must be provided, on the surface of which a leaf selected for casting from should be laid, in the most natural position the taste of the artist can effect, by banking up the sand beneath its more elevated parts by the lateral pressure of the blade of a knife; when the leaf has been supported in every part, its surface should, by means of a broad camel hair pencil, be covered over by a thin coating of wax and burgundy pitch, rendered fluid by heat: the leaf being now removed from the sand and dipped into cold water the wax becomes hard, and at the same time sufficiently tough to allow the leaf being ripped off from the wax mould, without altering the form of the latter. The wax mould is now placed on the sand, and banked up in every part, as the leaf at first was; and then an edge or border being raised or sand around the leaf, at a sufficient distance, very thin plaster of Paris is then poured over the leaf, and a camel-hair pencil is used to brush the fluid plaster into every hollow on the surface, and exclude air-bubbles. As soon as the plaster is set, it will be found on taking it up from the sand, that the heat generated during the setting of the plaster, will have softened the wax, and that the same may be dexterously rolled up from the impression thereof on the plaster; and thus the most beautiful and perfect moulds may be obtained for making any number of plaster casts in relievo, of the leaf which has been selected.

ON MOUTH GLUE, AND JOINING SHEETS OF DRAWING PAPER.

Mouth glue is the best substance hitherto known for joining several sheets of paper together, when a single sheet is not of sufficient size to hold the design.

This glue is in fact nothing but the common glue scented, in order to take away the disagreeable smell and taste. For this purpose, 4 oz. of the best English glue is broken to pieces, put into a glazed earthen or stone ware pipkin, and is floated with cold water: after remaing two or three days, the superfluous water is poured off, and the moistened and softened glue melted on a slow fire: when melted, 2 oz. of common sugar is added by degrees, and some also add a spoonful of lemon juice—but this appears useless. The melted glue is then poured out on a marble slab, about 18 inches square or even a wooden slab of the same size, a wall of wax being first made round the slab, and the whole rubbed with a rag well soaked with sweet oil. The mouth glue is left for four or five days to set, or until it can be removed in a cake, which is usually a quarter of an inch thick. After this a napkin, folded in four, is placed on a board, and being put over the glue, the whole is turned, so that the glue may lie upon the napkin; another of which, also folded in four, is warmed and placed on the cake of glue, and on that a board and weight. The cake is turned several times a day, for a fortnight, and each time covered with a warm napkin. At the expiration of this time it should be sufficiently firm to stand on its edge without bending; but by no means brittle. The greater the weight it is pressed with, the thinner does the cake become. When sufficiently dry, the cake is to be cut with scissors; and the pieces which are generally three inches long, eight or nine lines wide, and one line thick, are placed on the napkins so as not to touch one another. The use of the weight is to prevent the curling up of the glue as it dries, and the napkins to absorb the oil it takes from the mould.

The two pieces of paper which are to be joined, are to be cut very straight with a penknife and steel rule; and if the paper is sufficiently thick, both the edges may, by an expert artist, be cut half-way through, so as not to increase the thickness. If this is not the case, the sheets are to be laid so that the slight bur made by the knife may be as little perceived as possible, which is done by putting one sheet with its right face, *i.e.* that on which the paper mark is read aright uppermost, and the other sheet with the other face uppermost; then cutting the edge, and afterwards turning them so that both may have their right face uppermost, and with their edges overlapping one another about a line or two, and a slip of paper, also cut very straight, is laid on the under sheet, so as to meet the edge of the upper as close as possible. Both sheets, and this slip, are kept in their places by rules loaded with weights, and nicks are made on each side to show if any derangement takes place. A piece of the glue, sharpened at the point, being then held in the mouth, between the teeth, for three or four minutes, is to be taken out and rubbed between the edges of the paper in the middle of the joining, for about the breadth of an inch and a half. This being done as quickly and lightly as the artist can, a piece of paper is put on the joining, and the place is rubbed with an ivory knife, or the handle of an office penknife. A fresh piece on one side of this joining is then glued in the same manner; and then one on the other side, and so on alternately, first one side and then the other, until the whole of the edges are joined. The paper is to be shifted a little on the table each time, that it may not be accidentally glued to it, by the oozing of any part of the glue; and care must be taken that the glue be not rubbed too hard on the paper.

This operation, which requires great neatness, is best done when the sheet which is to be undermost lies next the artist. Many, for fear of having a pucker in the joint, begin at the end next the left hand and proceed to the right.

MISCELLANIES.

Moisture in Plants.—The quantity of simple moisture, or rather of pure water which some plants raise from the earth is uncommonly great. This is beautifully exemplified in the organization of some creeping plants, in which the moisture is frequently conveyed the distance of forty, or fifty, or a hundred yards, before it reaches the leaves or fruit, or perhaps the assimilating organs of the vegetable. A plant of this sort having been accidently cut across, continued to pour out pure, limpid, and tasteless water, in such a quantity as to fill a wine-glass in about half an hour.

Method of impregnating Water with Iron.—Place a few pieces of silver coin, alternating with pieces of sheet iron, in water. It will soon acquire a chalybeate taste, and a yellowish hue, and in twenty-four hours flakes of oxide of iron will appear. Hence if we replenish with water a vessel in which such pile is placed, after each draught, we may have a competent substitute for a chalybeate spring.

Clean copper-plates alternating with iron, or a clean copper wire entwined on an iron rod, would

prodoce the same effect; but as the copper also yields an oxide, which is poisonous, it is safer to employ silver.

Remarkable Propagation of Wind.—Whilst the bells were ringing to church et Alheny, on the 12th nf July, 1829, a very violent gust of wind from the south-east passed over the town. This gust passed over New York, which is to the south of Alhany, when the serviee had proceeded for some time: so that this south wind was rendered evident in the northern town an honr nearly before it was felt et the southern position; and it had been propagated from north to south in the directioo exactly contrary to thet in which it hlew.

Franklin remarked, that violent north-west winds in the United States frequeotly had their origin in the quarter towards which they passed, and wes inclined to attrihute them to great end sudden alterations in the atmosphere of the Gulf of Mexico. To explain the present instance in the same manner, a diminutioo in the etmospheric pressnre to the north of Albany must be considered as having occurred.—*Ann. de Chimie.*

ANSWERS TO QUERIES.

60.—*Why do lobsters become red by boiling?* Because particles of the shell in lohsters experience, by the effect of heat in boiling, a change nf position, which renders them fit to ahsorh all the rays of light, except the red which they reflect.

72.—*What is the reason that a razor cuts better after being dipped in hot water?* Because the heat, hy expanding the metal, in a greet degree obliterates the irreguleritlea of the edge of the instrument.

73.—*Why do the sun-beams extinguish a fire?* Because the air heing rarified hy the sun's heat a sufficiency of it does not reach the fire—on the contrary, when the air is coldest the fire hurns hrightest, it heing then hest supplied with oxygen.

75.—*Why does the freezing of flesh preserve it from putrefaction?* Beceuse one of the necessery conditions of putrefaction is e certain degree of temperatnre, and as this is ahove the freezing point, of course flesh when colder than that cannot hecome putrescent.

76.—*When a sudden thaw comes why are the outside walls of our houses covered with hoar frost?* Because the wells cannot be restored so suddenly to a warmer state as the eir, therefore any perticles of moisture settling upon them will, for a time, be frozen, althongh a general thaw mey have commenced around.

83.—*Is there any method to preserve steel goods from rust?* A thin coating of caoutchoue is recommended. It is an excellent preservative of iron end steel articles from the action of the eir and moistnre; its nnalterability, consistence when heated, adhesion to iron and steel, and facility of removal, renders it an admirahle snbstance for this pnrpose. The caoutchonc is to be melted in a close vessel, that it may not inflame. It will require nearly the temperature of fusing lead, and must be stirred to prevent hurning. Mix some nil with the caontchoue, which renders it easily applicahle; and leaves the substance, when dry, as a firm varnish, impervious to molsture. This, when required, may easily be remnved hy a soft hrush, dipped in warm oil of turpentine. H. S. F

[Mr. Pepys preserved steel goods hy a far more philosophical method—that is, hy merely wrapping them in zinc foil. He found thet a tahle kolfe, with a piece nf zinc wrapped round it, was preserved from rust, though soaked for a month in sea water, while another knife, oot connected with zinc, was very mnch corroded. This is evailehle where the last receipt is not, particularly in the exportation of cutlery. Tahle knives are best kept from rust hy having the ferules made nf zinc, nr, if not in nse, hy being wrapped in zinc foil, or in a cloth with pieces of zino. Knife boxes, scissor sheaths, sword cases, &c., should always be made of zinc.—Ed.]

90.—*Is there any method of removing stains or yellow spots from books or prints, that have been controcted by damp?* Dissolve chloride of soda in water, and wash it nver the print, &c., which will restore much of its original clearness of color; end, unless the mixture he very strong, the texture of the paper and color of the ink will not be injured.

104.—*What sort of gum or glue do the modellers in card-board use?* Common gum, mixed with fleke white or whitening, till the whole is of e thick pesty consistence.

109.—*What is Kyan's anti-dry rot composition?* Answered on page 156.

112.—*What points of comparative difference are there between common and voltaic electricity?* Common electricity makes gold leaves diverge, voltaic does not. Common electricity decomposes water with difficulty, voltaic very readily does so. In common electricity when any decomposition takes place, the elements do not seek particular poles or parts of the apparatus, in voltaic they alweys do.

117.—*How are straw hats whitened?* They are first washed with soap and water, end then placed in a hox along with hurning sulphur for an hour.

118.—*How is bees'-wax bleached?* By heing rolled out into very thin rihbons, and spread for some time upon the grass—thet it may be exposed to the sun and wind.

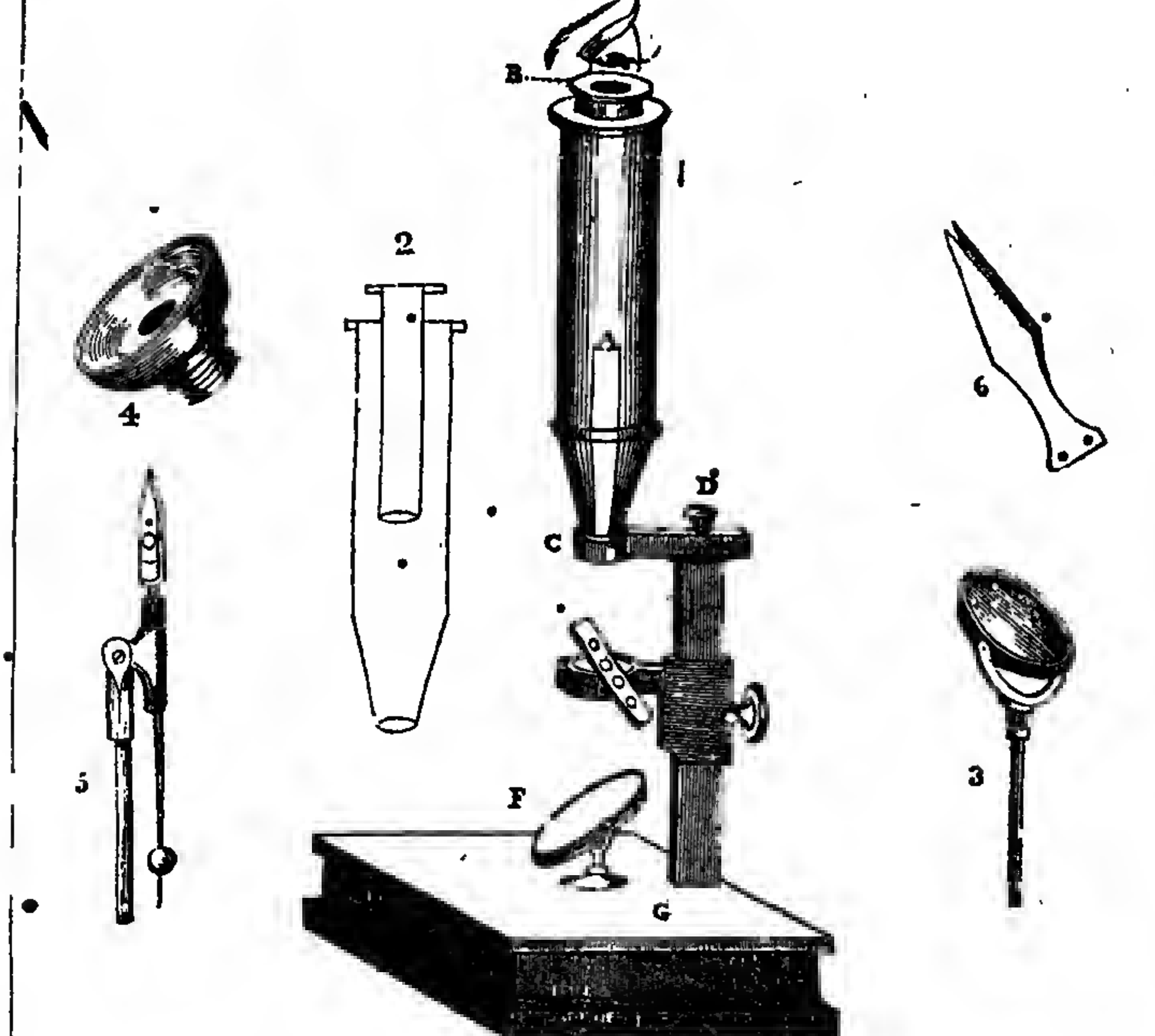
To the Editor.

Sir.—The enormous price charged hy opticians for covered copper wire, and a desire to diminish as mnch as possible the expense of electro-megnetic studies, indnces me to inform yonr readers how they mey get it cheaper.

Those who cover honnet wire charge about 6*d.* per ponnd. It is only necessary then to discover e wire coverer, end supply him with the copper wire: as, thns, it will not cost one-third the optician's charge. A man of this description, whose neme is Green, and who lives neer the western end of Quaker Street, Spitalfields, covered lately 2½ pounds of copper with silk for 3*s.* 6*d.* The first cost of the wire, which was No. 16, was 1*s.* 3*d.* per pound—thus I had 2½ pounds nf well-covered wire for 6*s.* 7½*d.* Smaller wire in proportioo. When covered with cotton it is abont 4*d.* per pound less.—I remein, your's respectfully, G. F.

55, Great Prescot Street

P.S. Though this letter was once inserted in the "Annals of Electricity," it will not diminish its utility here.



MICROSCOPES.

There are two principal varieties of the Microscope, the *Simple Microscope*, or Mounted Lens, and the *Compound Microscope*.

The Simple Microscope is a little instrument, intended to render the use of a simple lens more convenient and less fatiguing. In respect to the clearness and distinctness of the image, no other magnifying instrument can be compared with it. The others excel it only in the degree of their magnifying powei, and in the size of their fields of vision. The construction of the instrument, as figured in the plate, No. 1, is amply sufficient for all the purposes of microscopical scientific investigation. It is represented with the barrel A, &c., appertaining to a compound instrument; but it becomes a Simple Microscope by merely unscrewing the barrel at the lower end, leaving on, or else screwing in its place, a single lens.

Let A be a tube of four inches long, placed vertically, and shaped like a frustrum of a cone at its lower extremity; into the narrower end of this, at C, is inserted a lens of short focus, which is called the object glass. The two lenses, which form the eye-glass, are adapted to the opposite end of the tube by means of a short tube B, which slides up and down within the principal one, as seen in section in Fig. 2. The whole of the inner surfaces of these tubes are painted black, but not with a glossy color, in order to intercept all the rays which do not pass directly through the various

lenses. C is a horizontal arm, connected with the upright support by means of a screw at D. This arm supports the lens tube, or body of the instrument. Upon the upright support is seen the object frame, which is capable of motion up and down, and may be fixed at any point by the screw at the back of it. The part underneath the lens is a ring of brass, into which it is necessary that a common piece of plate glass should fit, or a small watch glass is extremely convenient for viewing solutions, living insects, &c. Across this part the various sliders of objects are placed; and, as will be seen, are capable of lateral motion in every direction, to adjust them to the proper focus. F is a reflector, suspended upon and moveable in a frame, that thus it may be turned so as to reflect the light either of the sun, or of a candle. G is the box, serving as a stand, and being furnished with a drawer to hold the various parts of the instrument when not in use.

Fig. 2 shows a section of the body.

Fig. 3 is a moveable double-convex lens, which is used to illuminate the surface of opaque objects by transmitted or direct light. It fits into a hole made in the object frame, and sometimes is furnished with its own distinct stand. It is placed between the light, and the object to be examined.

Fig. 4 is a semi-circular metallic reflector, to be screwed upon the lower end of the tube, beneath the lens at C, Fig. 1—to reflect the light which passes upwards from E on to any opaque object placed upon the frame to be examined—as, by day-light, the lens No. 3, cannot always be so conveniently used, because it then acts as a burning glass—that is, if used to converge the sun's rays.

Fig. 5 is a small pair of steel forceps, to be used for the purpose of holding any small object intended for examination. It is moveable backwards and forwards in its socket, as well as up and down by a joint, at the end of a stem, which fits a hole made in front of the object frame. At the other end of the forceps is a needle, with a small piece of ivory screwed upon it near the end, which is blackened on one side, while the other remains white; both the ivory and needle point are for the holding of such objects as it may be most convenient thus to examine.

Fig. 6 is a pair of hand forceps, for the purpose of taking up an object from the table, &c. It is made of a piece of thin brass, cut into proper shape, and doubled or rivetted at the heel. As too much light is to be deprecated in using the microscope, it is useful to have a diaphragm, such as a piece of fine gold-beater's skin, fastened to a frame or ring in such a manner that it may readily be attached under the object frame, and thus, by softening the light and preventing any unnatural glare, render the object more clearly definable.

The following observations on the comparative merits of various descriptions of Microscopes, from Raspail's "Organic Chemistry," are so true, and of such general value, that we quote them, rather than put his ideas into other words, as must be the case if we did not.

"The greater part of modern writers on the microscope, addressing themselves to the public whose approbation they courted, or to judges whose favor they solicited, although equally incapable of estimating the value of observations—these writers, I say, could find no better warrant for the exactness of their statements than the high character of the microscopes which they had used. 'We observed this,' they write in their essays, 'with the beautiful microscope of Adams with the excellent microscope of Selligue—with the incomparable microscope of Amica;' and all the world is charmed with the incontestible discovery made by the help of such powerful instrumente. There is in these pompous announcements a mixture of charlatanism and simplicity. These authors make use of a form of language which their predecessors had used before them; it was the customary passport to the crown which credulity was about to award them. I presented myself, with observations made by a rude instrument, a single lens of the value of 2 fr. (1*s.* 8*d.*) mounted in a copper frame, fastened into a block of wood; and I had the audacity to attack the splendid observations of our rich philosophers. It was a desperate contest, as might be expected when unprotected poverty ventured to knock at the gates of the sanctuary in which science was enshrined by fortune. The principles which I then laid down having been since generally admitted, it will be sufficient to state them shortly.

"With a single mounted lens, a magnifying power of 150 diameters may be obtained. The rays of light, having but two surfaces to traverse, only twice experience the aberrations of sphericity and refrangibility. Therefore it is obvious that the image will be sharper and more clear than with any other microscope.

"But it will be said, with the compound microscope we obtain a power of from 1000 to 2000 diameters. What a superiority is here! this would be in some degree true, if, along with these enormous enlargements, the image preserved the sharpness and clearness which it has when seen by a single lens. But this is altogether impossible with a power of even 800 diameters; for the rays having so many surfaces to traverse in the compound microscope, consequently suffer so much loss, that the image which the eye perceives has a certain confusion which fatigues it, and prevents any thing more from being thus discovered than by the single lens. Clearness is a sufficient compensation for the want of enlargement. What does it signify to me in fact, if you show me giants when I can scarcely distinguish them in the mist?

"Besides, if we could suppose that instruments of such power could give us images as distinct as their makers promise, the superiority of the compound microscope will not be so marvellous as it appears to be, if the difference be reduced to its most simple expression. For, with an enlargement of 1000, the compound microscope would only enlarge the object six times as much as the single lens of the simple microscope; and this is an advantage which attention and the habit of observing will in a very complete manner supply. Besides, the great difference of size which we find in an organ, according to the species from which it is taken, tends also to diminish the importance of this advantage, and to render it, so to speak, accidental. For the organ which in one species was inappreciable by a single lens, I have found in another species possessed of such dimensions, that it has appeared to me possible to dissect it by the aid of the simple microscope.

"The advantages of compound microscopes in general, over simple ones, consist in enlarging the field of vision—in obtaining a great magnifying power while the object is at a greater distance from the object-glass—and in permitting the dissection of the object to be performed as by direct vision.

"But I repeat, that these advantages are not such that the value of these observations depends on them. I possess a good compound microscope, and have had within my reach the best microscopes, and yet I still willingly recur to my modest mounted lens, and sometimes give it the preference to any other. It ought to be recollected that the beautiful observations of Swammerdam were almost all made with a single lens."

WATER AS AN ALIMENT.

Rain Water, when collected in the open fields, is certainly the purest natural water, being produced as it were by a natural distillation. When, however, it is collected near large towns, it derives some impregnation from the smoky and contaminated atmosphere through which it falls; and if allowed to come in contact with the houses, will be found to contain calcareous matter; in which case it ought never to be used without being previously boiled and strained. Hippocrates gave this advice; and M. Margraaf, of Berlin, has shown the wisdom of the precaution, by a satisfactory series of experiments.

Spring Water, in addition to the substances detected in rain water, generally contains a small portion of muriate of soda, and frequently other salts: but the larger springs are purer than the smaller ones; and those which occur in primitive countries, and in silicious rocks, or beds of gravel, necessarily contain the least impregnation. An important practical distinction has been founded upon the fact, that the water of some springs dissolves soap, while that of others decomposes and curdles it; the former has been termed soft, the latter hard, water. Soft water is a more powerful solvent of all vegetable matters, and is consequently to be preferred for domestic as well as medicinal purposes. The brewer knows well, from experience, how much more readily and copiously soft water will dissolve the extractive matter of his malt; and the housewife does not require to be told, that hard water is incapable of making good tea. Sulphate of lime is the salt which generally imparts the quality of hardness to water; and it has been said that its presence will sometimes occasion an uneasy sense of weight in a weak stomach. The quantity of this salt varies considerably; but, in general, it appears that the proportion of five grains in a pint of water will constitute hardness, unfit for washing with soap, and for many other purposes of domestic use. Animals appear to be more sensible of the impurities of water than man. Horses, by an instinctive sagacity, always prefer soft water; and when, by necessity or inattention, they are confined to the use of that which is hard, their coats become rough and ill-conditioned, and they are frequently attacked with the gripes. Pigeons are also known to refuse hard, after they have been accustomed to soft water.

River Water.—This being derived from the conflux of numerous springs with rain water, generally possesses considerable purity; that the proportion of its saline contents should be small, is easily explained by the precipitation which must necessarily take place from the union of different solutions: it is, however, liable to hold in suspension particles of earthy matter, which impair its transparency, and sometimes its salubrity. This is apparently the case with the Seine, the Ganges, and the Nile: but as the impurities are, for the most part, only suspended, and not truly dissolved, mere rest, or filtration will therefore restore to i[illegible] The chemist, therefore, after such a process, would be unable to distinguish water at London from that at Hampton Court. There exists a popular belief, that the water of the Thames is peculiarly adapted for the brewery of porter; it is only necessary to observe, that such water is never used in the London breweries. The vapid taste of river, when compared with spring water, depends upon the loss of air and carbonic acid, from its long exposure.

Well Water is essentially the same as spring water, being derived from the same source; it is, however, more liable to impurity from its stagnation or slow infiltration: hence our old wells furnish much purer water than those which are more recent, as the soluble particles are gradually washed away. Mr. Dalton observes, that the more any spring is drawn from, the softer the water will become.

Soft Water has been supposed to be unwholesome, and in particular to produce bronchocele, from the prevalence of that disease in the Alps; but it does not appear upon what principle its insalubrity can depend. The same strumous affection occurs at Sumatra, where ice and snow are never seen; while, on the contrary, the disease is quite unknown in Chili and Thibet, although the rivers of those countries are supplied by the melting of the snow with which the mountains are covered. The same observations will apply to ice water. The trials of Captain Cook, in his voyage round the world, prove its wholesomeness beyond a doubt: in the high southern latitudes he found a salutary supply of fresh water in the ice of the sea. "This melted ice," says Sir John Pringle, "was not only sweet but soft, and so wholesome as to show the fallacy of human reasoning, unsupported by experiments." When immediately melted, snow water contains no air, as it is expelled during the act of freezing, consequently it is remarkably vapid: but it soon recovers the air it had lost by exposure to the atmosphere.

Lake Water is a collection of rain, spring, and river waters, contaminated with various animal and vegetable matters, which from its stagnant nature have undergone putrefaction in it. This objection may be urged with greater force against the use of water collected in ponds and ditches, and which the inhabitants of some districts are often under the necessity of drinking. An endemic diarrhœa has been know to arise from such a circumstance.

Marsh Water, being the most stagnant, is the most impure of all water, and is generally loaded with decomposing vegetable matter. There can be no doubt, that numerous diseases have sprung up from its use.

WAX FIGURES.

In ancient Greece, wax was used for impressions of seals, for encaustic painting, and for a varnish for marble walls and statues. There was also a distinct class of artists, called *puppet-makers* by the Greeks, and *sigillarii* by the Romans who worked only, or chiefly, in wax. Figures of beautiful boys in wax often adorned the bed-rooms of the Greeks. The subjects most frequently represented in wax, however, belonged to the vegetable kingdom, being branches, fruits, flowers, wreaths, &c. It was customary to construct a little garden of flower pots and fruit baskets, in every house, in honor of Adonis, at the time of his feast; but as this was

celebrated so early in the year that even in Greece it was difficult to find flowers and fruits; wreaths, cornucopiæ, fruits, &c. of wax, were used as substitutes. In sorcery, also, wax figures were employed; and Artemidorus tells us, in his work on Dreams, that waxen wreaths in dreams foreboded sickness and death. The notorious Heliogabulus set dishes of wax before his guests, to tantalize them with representations of all the luxuries in which he revelled. At present wax is used for imitations of anatomical preparations, or of fruits; it also serves the sculptor for his models and studies, also for little portrait figures in *basso relievo.* The latter can be executed with delicacy and beauty; but wax figures of the size of life, which are often praised for their likeness, overstep the proper limit of the fine arts. The attempt to imitate life too closely, which in contrast with their ghastly fixedness, has a tendency to make us shudder. In the genuine work of art there is an immortal life, in idea, which speaks to our souls without attempting to deceive our senses. The wax figure seems to address the mortal in us; it is a petrified picture of our earthly parts. The line at which a work of art should stop, in its approach to nature, is not distinctly marked; but it cannot be overstepped without affecting us disagreeably. In Florence, all parts of the human body are, at present, imitated, in colored wax, for the study of anatomy. More than thirty rooms in the palace are filled with these wax preparations; also plants are found there imitated to deception, in wax. Exact imitations in wax of vegetable productions do not produce the same unpleasant emotions as wax images of men and animals, because they have, by nature, a more stationary character.

The first idea of forming figures of wax of this kind was conceived by Nones, of Genoa, a hospital physician in the seventeenth century. He was about to preserve a human body by embalming it; but not being able to prevent putrefaction entirely, he conceived the idea of having the body imitated as accurately as possible in wax. The abbate Zumbo, a Sicilian, who understood nothing of anatomy, hut was skilled in working in wax, imitated the head of the body so perfectly, under the direction of Nones, in colored wax, that many who saw it took it to be the real head. Zumbo secretly made another copy, and went with it to France, where he pretended to have invented the art. He soon died. De Nones then had the whole body perfectly copied by a Frenchman, named De Lacroix. In 1721, La Courege exhibited similar figures in Hamburg; and, in 1737, others were publicly sold in London. The works of Ercole Lelli, Giovanni Manzolini and his wife, which were formerly preserved in the institute of Bologna, and were thence carried to Paris, were remarkable fine. Beautiful figures in wax, made by Anna Manzolinai, are preserved in Turin and Petersburg. She died in 1755. More modern artists in this line in Italy, are L. Calza, Filippo Balugani, and Ferrini. The celebrated Fontana, in Florence, carried this art to a high degree of excellence. He received so many orders that he employed a large company of anatomists, model cutters, wax-moulders, and painters. Yet he generally confined himself to representations of the intestines. Vogt, in the university of Wittenberg, used, in his lectures, wax preparations, in imitation of the fine branches of vessels. Pinson, and at a later period, Laumonier, at Rouen, distinguished themselves in this department, in France. The composition for this purpose consists of four parts wax, three parts white turpentine, and some olive oil, or hog's lard, suitably colored. The bulk of the figure is formed with the hands, the finer parts are made with instruments of various forms; some figures are cast. The moulds ought to be of gypsum, and consist of many pieces, covered inside with oil. The wax is poured into a hole at the feet, and the whole is then thrown into cold water, that the wax may be separated the more easily.

INKS.

Black Ink.—Nut-galls, sulphate of iron, and gum, are the only substances truly useful in the preparation of ordinary ink; the other things often added merely modify the shade, and considerably diminish the cost to the manufacturer upon the great scale. Many of these inks contain little gallic acid, or tannin, and are therefore of inferior quality. To make 12 gallons of ink we may take,

12 pounds of nutgalls,
5 pounds of green sulphate of iron,
5 pounds of gum senegal,
12 gallons of water.

The bruised nutgalls are to be put into a cylindrical copper, of a depth equal to its diameter, and boiled, during three hours, with three fourths of the above quantity of water, taking care to add fresh water to replace what is lost by evaporation. The decoction is to be emptied into a tub, allowed to settle, and the clear liquor being drawn off, the lees are to be drained. Some recommend the addition of a little bullock's blood or white of egg, to remove a part of the tannin. But this abstraction tends to lessen the product, and will seldom be practised by the manufacturer intent upon a large return for his capital. The gum is to be dissolved in a small quantity of hot water, and the mucilage, thus formed, being filtered, is added to the clear decoction. The sulphate of iron must likewise be separately dissolved, and well mixed with the above. The color darkens by degrees in consequence of the peroxidizement of the iron, on exposing the ink to the action of the air. But ink affords a more durable writing when used in the pale state, because its particles are then finer, and penetrate the paper more intimately. When ink consists chiefly of tannate of peroxide of iron, however black, it is merely superficial, and is easily erased or effaced. Therefore whenever the liquid made by the above prescription has acquired a moderately deep tint, it should be drawn off clear into bottles, and well corked up. Some ink-makers allow it to mould a little in the casks before bottling, and suppose that it will thereby be not so liable to become mouldy in the bottles. A few bruised cloves, or other aromatic perfume, added to ink, is said to prevent the formation of mouldiness, which is produced by the growth of minute fungi.

The operation may be abridged, by peroxidizing the copperas beforehand, by moderate calcination in an open vessel; but, for the reasons above assigned, ink made with such a sulphate of iron, however agreeable to the ignorant, when made to shine with gum and sugar, under the name of japan ink, is neither the most durable nor the most pleasant to write with.

From the comparatively high price of gall-nuts, sumach, logwood, and even oak bark, are too frequently substituted, to a considerable degree, in the manufacture of ink.

The ink made by the prescription given above, is much more rich and powerful than many of the inks commonly sold. To bring it to their standard, a half more water may safely be added, or even 20 gallons of tolerable ink may be made from that weight of materials.

Sumach and logwood admit of only about one-half of the copperas that galls will take to bring out the maximum amount of black dye.

Chaptal gives a prescription in his *Chimie appliquee aux arts,* which like many other things in that work, are published with very little knowledge and discrimination. He uses logwood and sulphate of copper in addition to the galls and sulphate of iron; a pernicious combination productive of a spurious fugitive black, and a liquor corrosive of pens. It is in fact, a modification of the dye of the hatters.

Lewis, who made exact experiments on inks, assigned the proportion of 3 parts of galls to 1 of sulphate of iron, which, with average galls, will answer very well; but good galls will admit of more copperas.

Gold Ink is made by grinding upon a porphyry slab, with a muller, gold leaves along with white honey, till they be reduced to the finest possible division. The paste is then collected upon the edge of a knife or spatula, put into a large glass, and diffused through water. The gold by gravity soon falls to the bottom, while the honey dissolves in the water, which must be decanted off. The sediment is to be repeatedly washed till entirely freed from the honey. The powder, when dried, is very brilliant, and when to be used as an ink, may be mixed up with a little gum water. After the writing becomes dry, it should be burnished with a wolf's tooth.

Silver Ink is prepared in the same manner.

Indelible Ink.—A very good ink, capable of resisting chlorine, oxalic acid, and ablution with a hair pencil or sponge, may be made by mixing some of the ink made by the preceding prescription, with a little genuine China ink. It writes well. Many other formulæ have been given for indelible inks, but they are all inferior in simplicity and usefulness to the one now prescribed. Solution of nitrate of silver thickened with gum, and written with upon linen or cotton cloth, previously imbued with a solution of soda, and dried, is the ordinary permanent ink of the shops. Before the cloths are washed, the writing should be exposed to the sun-beams, or to bright daylight, which blackens and fixes the oxide of silver. It is easily discharged by chlorine and ammonia.

Red Ink.—This ink may be made by infusing, for three or four days, in weak vinegar, Brazil wood chipped into small pieces; the infusion may be then boiled upon the wood for an hour, strained, and thickened slightly with gum arabic and water. A little alum improves the color. A decoction of cochineal with a little water of ammonia, forms a more beautiful red ink, but it is fugitive. An extemporaneous red ink of the same kind may be made by dissolving carmine in weak water of ammonia, and adding a little mucilage.

Green Ink.—According to Klaproth, a fine ink of this color may be prepared by boiling a mixture of 2 parts of verdigris in 8 parts of water, with 1 of cream of tartar, till the total bulk be reduced one-half. The solution must be then passed through a cloth, cooled, and bottled for use.

Yellow Ink is made by dissolving 3 parts of alum in 100 of water, adding 25 parts of Persian or Avignon berries bruised, boiling the mixture for an hour, straining the liquor, and dissolving it in 4 parts of gum arabic. A solution of gamboge in water forms a convenient yellow ink.

By examining the different dye-stuffs, and considering the process used in dyeing with them, a variety of colored inks may be made.

China Ink.—Proust says, that lamp-black purified by potash lye, when mixed with a solution of glue, and dried, formed an ink which was preferred by artists to that of China. M. Merimée says, that the Chinese do not use glue in the fabrication of their ink, but that they add vegetable juices, which render it more brilliant and more indelible upon paper. When the best lamp-black is levigated with the purest gelatine or solution of glue, it forms, no doubt, an ink of a good color, but wants the shining fracture, and is not so permanent on paper, as good China ink; and it stiffens in cold weather into a tremulous jelly. Glue may be deprived of the gelatinizing property by boiling it for a long time, or subjecting it to a high heat in a Papin's digester: but as ammonia is apt to be generated in this way, M. Merimée recommends starch gum made by sulphuric acid, (British gum,) to be used in preference to glue. He gives, however, the following directions for preparing this ink with glue. Into a solution of glue he pours a concentrated solution of gall-nuts, which occasions an elastic resinous-looking precipitate. He washes this matter with hot water, and dissolves it in a spare solution of clarified glue. He filters anew, and concentrates it to the proper degree for being incorporated with the purified lamp-black. The astringent principle in vegetables does not precipitate gelatine when its acid is saturated; as is done by boiling the nut-galls with lime water or magnesia. The first mode of making the ink is to be preferred. The lamp-black is said to be made in China by collecting the smoke of the oil of sesame. A little camphor (about 2 per cent.) has been detected in the ink of China, and is supposed to improve it. Infusion of galls renders the ink permanent on paper.

ELASTIC MOULDS.

Being much engaged in taking casts from anatomical preparations, Dr. Douglas Fox, Surgeon, of Derby, found great difficulty, principally with hard bodies, which, when undercut, or having considerable overlaps, did not admit of the removal of moulds of the ordinary kind, except with injury. These difficulties suggested to him the use of elastic moulds, which, giving way as they were withdrawn from complicated parts, would return to their proper shape; and he ultimately succeeded in making such moulds of glue, which not only relieved him from all his difficulties, but were attended with great advantages, in consequence of the small number of pieces into which it was necessary to divide the mould.

The body to be moulded, previously oiled, must be secured one inch above the surface of a board, and then surrounded by a wall of clay, about an inch distant from its sides. The clay must also extend rather higher than the contained body: into this, warm melted glue, as thick as possible so that it will run, is to be poured, so as to completely cover the body to be moulded: the glue is to remain till cold, when it will have set into an elastic mass, just such as is required.

Having removed the clay, the glue is to be cut into as many pieces as may be necessary for its removal, either by a sharp-pointed knife, or by having placed threads in the requisite situation of the body to be moulded, which may be drawn away when the glue is set, so as to cut it out in any direction.

The portions of the glue mould having been removed from the original, are to placed together and bound round by tape.

In some instances it is well to run small wooden pegs through the portions of the glue, so as to keep them exactly in their proper positions. If the mould be of considerable size, it is better to let it be bound with moderate tightness upon a board, to prevent it bending whilst in use; having done as above described, the plaster of Paris, as in common casting, is to be poured into the mould, and left to set.

In many instances wax may also be cast in glue, if it is not poured in whilst too hot; as the wax cools so rapidly when applied to the cold glue, that the sharpness of the impression is not injured.

Glue has been described as succeeding well where an elastic mould is alone applicable; but many modifications are admissible. When the moulds are not used soon after being made, treacle should be previously mixed with the glue, to prevent its becoming hard.

The description thus given is with reference to moulding those bodies which cannot be so well done by any other than an elastic mould; but glue moulds will be found greatly to facilitate casting in many departments, as a mould may be frequently taken by this method in two or three pieces, which would, on any other principle, require many.

ELECTRICITY.

(Resumed from page 131.)

TWO THEORIES OF ELECTRICITY.

In a very early stage of electrical inquiry, it was observed that there was a remarkable difference of effect manifested by different substances when excited. *Ex.*—Charge two insulated pith balls by holding near them an excited glass tube, the balls will separate from each other; the same is the effect when both are charged by holding to them an excited stick of sealing wax, yet when one is electrified by the glass and the other by the wax, they are mutually attracted.

This circumstance gave rise to the opinion that two different species of the electric fluid existed, a theory first promulgated to the world by M. Du Fay, who called the two fluids by names accordant to the substances which produce them; that produced by the friction of glass he called vitreous, and that caused by exciting sealing wax, the resinous.

This opinion of Du Fay was eagerly adopted by the electricians of Europe, who by it were enabled to account for all the appearances their experiments elicited, but when it became known that the same substance sometimes showed the vitreous and sometimes the resinous, the names given to the two fluids became inapplicable, and when the Leyden phial was discovered, they were at a loss to explain its action by this hypothesis. Dr. Franklin, with his usual sagacity, founded the other theory; not indeed a perfect system, but one which rapidly ran over Europe and America, for it was the only one which could explain the action of the Leyden jar, which at that time engaged the whole attention of the learned. He imagined that there was but one fluid, and that all bodies whatever contained a certain quantity of that fluid; which quantity we may increase or decrease at our pleasure. When increased he styles it *plus*, or *positive* electricity, and when a diminution takes place, he calls it *minus*, or *negatively* electrified, which terms positive and negative are now universally applied when speaking of electrified bodies. Not being able to explain the action of the Leyden jar was not the only reason for doubting the truth of M. Du Fay's theory, for it was soon discovered that the same body showed sometimes the resinous, sometimes the vitreous effect; how could this be accounted for? On the other hand, by Franklin's hypothesis nothing is more easy. The different effect is produced by the state of the rubber, as it is found that when two substances are rubbed together, so as to exhibit electrical appearances, that one of them is always positive and the other negative. The following list of substances is so arranged, that when either is rubbed with any of the bodies placed above it, it becomes negative, and rubbed with any standing below it shows signs of positive electricity

Back of a cat.
Smooth glass.
Woollen cloth.
Feathers.
Wood.
Paper.
Silk.
Gum lac.
Roughened glass.

Thus if a tube of smooth glass be rubbed with a woollen cloth, or a silk handkerchief, it becomes electrified *positively*, as these bodies stand under it in the table, but if glass be rubbed with cat's fur it becomes *negative*; in the former case, it absorbs the fluids from the materials rubbed against it, and therefore becomes overcharged; in the latter case it shows a negative property, in consequence of parting with a portion of its natural share, to the cat's skin—thus, as Franklin would have said, it has a superfluity in one case, in the other a deficiency.

Nothing can possibly be more easy to understand than this, and in every case in which the theory can be applied, equal facility can be offered, or at any rate there is no fact which cannot be explained by this hypothesis, except indeed such as are equally unintelligible by the other also.

But in giving an opinion on any disputed point of philosophy, it is right to state the arguments for and against any particular view, and to institute a fair comparison, by explaining the foregoing experiment by means of Du Fay's theory. Those of his school believe that there are two electric fluids, antagonistic to each other, and that when one of these is by any means disturbed, the other is equally so—thus it supposes two causes for a single effect, certainly an anomaly in physics. In the rubbing of the glass tube with a woollen cloth, and thereby producing an electrical action, two fluids then are disturbed, which two, nevertheless, exist in each body; and when the glass and cloth are separated, still the fluids do not coalesce, though both are present in every portion of the glass, and also of the woollen. Why this is nobody can tell, nor is an attempt at explanation given at all. It has been said, that there are many circumstances to invalidate the Franklinian hypothesis—the strongest of which is, that when a shock is passed through a card there are often two holes made in it, there-

, there must necessarily be two fluids passing— of which has its appointed channel. Nothing be more easy than to explain the reason of e various perforations. Is it not, also, the fact t if the water of a river meets with an obstacle, divides into two streams, though it still passes in its general course? And thus it is with the ectric fluid. The card is the obstacle, being a bad nductor, which occasions the fluid to break into o streams—there are seldom more than two, ecause the fluid requires no more channels; sometimes, and, indeed, most frequently, but one, and then one hole only is apparent. The same experiment affords a second objection to the one-fluid theory. If a shock be passed through a damp card, a burr, or rough edge, will be found on each side of it, which some persons believe to be an incontestible proof of two fluids, one passing in each direction. The experiment really proves no such thing, and may be imitated many ways—by the passage of one body only through another: thus, when a leaden ball is fired from a musket against a sheet of copper, with sufficient force to pass through it, a double burr will be very plainly distinguishable; so also enlarge a hole that has been made in an iron hoop, with a semi-circular tapering bit, such as is used for metals, and a very strong burr will be found on each side of the hole. In these instances it is certain that but one body is in motion—why then should a similar appearance in the card prove that there are two fluids in motion? There is truly no appearance of a double stream in any electrical experiment whatever. Pass a shock over the surface of a card covered with vermillion, a single black mark will appear. In lightning there is but a flash in one direction, no counter flash meets it in its course. When a shock is sent along an exhausted glass tube, so as to imitate a falling star, or when a falling star is seen in the heavens, no other stream of fire is apparent; and also the circumstance of the luminous star visible on the negative side of the apparatus, and the brush on the positive side, is wholly inexplicable by the system of Du Fay, though nothing is easier by the more simple and more philosophical hypothesis of Franklin.

(Continued on page 177.)

MANUFACTURE OF WAFERS.

There are two manners of manufacturing wafers: 1, with wheat flour and water, for the ordinary kind; and 2, with gelatine. 1. A certain quantity of fine flour is to be diffused through pure water, and so mixed as to leave no clotty particles. This thin pap is then colored with one or other of the matters to be particularly described under the second head; and which are, vermillion, sulphate of indigo, and gamboge. The pap is not allowed to ferment, but must be employed immediately after it is mixed. For this purpose a tool is employed, consisting of two plates of iron, which come together like pincers or a pair of tongs, leaving a certain small definite space betwixt them. These plates are first slightly heated, greased with butter, filled with the pap, closed, and then exposed for a short time to the heat of a charcoal fire. The iron plates being allowed to cool, on opening them, the thin cake appears dry, solid, brittle, and about as thick as a playing-card. By means of annular punches of different sizes, with sharp edges, the cake is cut into wafers.

2. The transparent wafers are made as follows:—Dissolve fine glue, or isinglass, in such a quantity of water, that the solution, when cold, may be consistent. Let it be poured hot upon a plate of mirror glass, (previously warmed with steam, and slightly greased,) which is fitted in a metallic frame with edges just as high as the wafers should be thick. A second plate of glass, heated and greased, is laid on the surface, so as to touch every point of the gelatine, resting on the edges of the frame. By this pressure, the thin cake of gelatine is made perfectly uniform. When the two plates of glass get cold, the gelatine becomes solid, and may easily be removed. It is then cut with proper punches into discs of different sizes.

The coloring-matters ought not to be of an insalubrious kind.

For red wafers, carmine is well adapted, when they are not to be transparent; but this color is dear, and can be used only for the finer kinds. Instead of it, a decoction of Brazil wood, brightened with a little alum, may be employed.

For yellow, an infusion of saffron or turmeric has been prescribed; but a decoction of weld, fustic, or Persian berries, might be used.

Sulphate of indigo partially saturated with potash, is used for the blue wafers; and this mixed with yellow for the greens. Some recommend the sulphate to be nearly neutralized with chalk, and to treat the liquor with alcohol, in order to obtain the best blue dye for wafers.

Common wafers are, however, colored with the substances mentioned at the beginning of the article; and for the cheaper kinds, red lead is used instead of vermillion, and turmeric instead of gamboge.

LAYING OUT THE TEETH OF WHEELS.

As there are very uncommon and odd numbers of teeth in some of the wheels of astronomical clocks, and which, consequently, could not be cut by any common engine used by clock-makers for cutting the numbers of teeth in their clock-wheels, it is often necessary to divide the circumference of a circle into any given odd or even number of equal parts, so as *that* number may be laid down upon the dividing plate of a cutting engine.

There is no odd number, but from which, if a certain number be subtracted, there will remain an even number, easy to be subdivided. Thus, supposing the given number of equal divisions of a circle on the dividing plate to be 69; subtract 9, and there will remain 60.

Every circle is supposed to contain 360 degrees: therefore say, As the given number of parts in the circle, which is 69, is to 360 degrees, so is 9 parts to the corresponding arc of the circle that will contain them; which are, by the Rule of Three, will be found to be 46·95. Therefore by the line of chords on a common scale, or rather on a sector, set off 46·95 (or 46·9) degrees with your compasses, in the periphery of the circle, and divide that arc or portion of the circle into 9 equal parts, and the rest of the circle into 60; and the whole will be divided into 69 equal parts, as was required.

Again, suppose it were required to divide the circumference of a circle into 83 equal parts; subtract 3, and 80 will remain. Then, as 83 parts are to 360 degrees, so (by the Rule of Proportion,) are 3 parts to 13 degrees and one hundredth part of degree; which small fraction may be neglected.

Therefore, by the line of chords, and compasses, set off 15 degrees in the periphery of the circle, and divide that portion or arc into 3 equal parts, and the rest of the circle into 80; and the thing will be done.

Once more, suppose it were required to divide a given circle into 365 equal parts; subtract 5, and 360 will remain. Then, as 365 parts are to 360 degrees, so are 5 parts to 4·95 degrees. Therefore, set off 4·95 degrees in the circle; divide that space into 5 equal parts, and the rest of the circle into 360; and the whole will be divided into 365 equal parts, as was required.

Any person who is accustomed to handle the compasses, and the scale or sector, may very easily, by a little practice, take off degrees, and fractional parts of a degree, by the accuracy of his eye, from a line of chords, near enough the truth for the above-mentioned purpose.

BROWNING OF GUN-BARRELS AND OTHER ARMS.

By this process, the surface of several articles of iron acquires a shining brown color. This preparation, which protects the iron from rust, and also improves its appearance, is chiefly employed for the barrels of fowling-pieces and soldier's rifles, to conceal the fire-arms from the game and the enemy. The finest kind of browning is the Damascus, in which dark and bright lines run through the brown ground.

This operation consists in producing a very thin uniform film of oxide or rust upon the iron, and giving a gloss to its surface by rubbing wax over it, or coating it with a shell-lac varnish.

Several means may be employed to produce this rust speedily and well. The effect may be obtained by inclosing the barrels in a space filled with the vapour of muriatic acid. Moistening their surface with dilute muriatic or nitric acid, will answer the same purpose. But the most common material used for browning, is the butter or chloride of antimony, which, on account of its being subservient to this purpose, has been called *bronzing salt*. It is mixed uniformly with olive oil, and rubbed upon the iron slightly heated; which is afterwards exposed to the air, till the wished-for degree of browning is produced. A little aquafortis is rubbed on after the antimony, to quicken its operation. The brown barrel must be then carefully cleaned, washed with water, dried, and finally polished, either by the steel burnisher, or rubbed with white wax, or varnished with a solution of 2 ounces of shell-lac, and 3 drams of dragon's blood, in 2 quarts of spirit of wine.

The following process may also be recommended: Make a solution with half an ounce of aquafortis, half an ounce of sweet spirit of nitre, 1 ounce of spirit of wine, 2 ounces of sulphur of copper, and 1 ounce of tincture of iron, in so much water as will fill altogether a quart measure. The gun barrel to be browned must first of all be filed and polished bright, and then rubbed with unslaked lime and water to clear away all grease. Its two ends must now be stopped with wooden rods, which may serve as handles, and the touch-hole must be filled with wax. The barrel is then to be rubbed with that solution, applied to linen rags or a sponge, till the whole surface be equally moistened; it is allowed to stand 24 hours, and is then scrubbed with a stiff brush. The application of the liquid and the brushing may be repeated twice or oftener, till the iron acquires a fine brown color. After the last brushing, the barrel must be washed with plenty of boiling water, containing a little potash; then washed with clean water, dried, rubbed with polishing hard wood, and coated with shell-lac varnish, for which purpose the barrel must be heated to the boiling point of water. It is finally polished with a piece of hard wood.

Storch recommends to make a browning solution with 1 part of sulphate of copper, 1 third of a part of sulphuric ether, and 4 parts of distilled water.

To give the damask appearance, the barrel must be rubbed over first with very dilute aquafortis and vinegar, mixed with a solution of blue vitriol; washed and dried, and rubbed with a hard brush to remove any scales of copper which may be precipitated upon it from the sulphate.

MISCELLANIES.

Metallochromy.—M. Bottiger has obtained some remarkable effects in metallic coloration, by plunging a plate of platina, held in contact with a zinc stem, in a solution of ammoniacal chloride of copper; the platina being consequently maintained in an electro-negative state. The solution of the copper was obtained by agitating fine copper-filings in a saturated solution of sal-ammoniac. This solution of copper, which is colorless as long as it is kept in a well-stopped bottle, becomes blue by exposure to the air. If a piece of polished platina be plunged into it no effect is produced, but if the platina be touched by a piece of zinc, a thin red pellicle of copper is immediately deposited on the surface, which immediately disappears if the contact with zinc was momentary; but if this contact is permanent, beautiful shades of yellow, green, red, brown, and black, soon appear on the platina. These colors may be fixed by withdrawing the platina, and leaving it to dry in the air.

Manufacture of Shot.—In melting the lead, a small quantity of arsenic is added, which disposes it to run into spherical drops. When melted, it is poured into a cylinder whose circumference is pierced with holes. The lead streaming through the holes, soon divides into drops which fall into water, where they congeal. They are not all spherical; therefore, those that are must be separated, which is done by an ingenious contrivance. The whole is sifted on the upper end of a long smooth inclined plane, and the grains roll down to the lower end. But the pear-like shape of the bad grains makes them roll down irregularly, and they waddle as it were to a side; while the round ones run straight down, and are afterwards sorted into sizes by sieves. The manufacturers of the patent shot have fixed their furnace, for melting the metal, at the top of a tower 100 feet high, and procure a much greater number of spherical grains, by letting the melted lead fall into water from this height, as the shot is gradually cooled before it reaches the water.

Composition for Sculptors' Models.—A composition, of which sculptors form their best models, consists of 16 parts wax, 2 parts Burgundy pitch, or shoemaker's wax, and 1 part hog's lard; or of 10 parts wax, 1 turpentine, as much shoemaker's wax, and as much hog's lard. This is melted by a slow fire, and afterwards well stirred and strained.

Fig. 1.

ANALYSIS OF MINERALS.

THE MOUTH BLOW-PIPE.

In the chemical analysis of mineral substances, it is generally necessary first to submit them to the action of the blow-pipe; by which operation their general nature is most frequently determined, and should not the heat to which they are now subjected reveal all their constituent principles, it will show at least some of them, and render the remainder more easily to be detected by the tests to be applied afterwards. The construction and manner of using this valuable instrument in its more simple forms will afford a good subject for the present paper.

Originally the mouth blow-pipe was only a simple conical tube, more or less curved towards its point, and terminated by a very small circular opening.

Fig. 2.

By means of this a current of air is carried against the flame of a candle, and the inflamed matter of the wick is directed upon small objects, of which it is desirable to elevate the temperature. Workers in metal still derive immense advantages from this little instrument. They employ it in the soldering of very small articles, as well as for heating the extremities of delicate tools in order to temper them. Since the blow-pipe has fallen into the hands of mineralogical chemists its form has been subjected to a series of important modifications: one of them is having a bulb upon the stem, whereby the moisture of the breath is retained, and, therefore, the jet of air at the orifice is stronger and steadier. This form of blow-pipe is represented in

Fig. 3.

It was first used by the celebrated chemist, Bergman. Many other chemists modified the above. Black's blow-pipe was a tube narrowest at the mouth, and having a small jet, sideways on the principal tube. This required a less constrained position of the hands than the former. Wollaston used a small tube, similar to Fig. 2, but straight,

and with a jet set sideways upon it, but not quite at the end. Pepys invented an instrument which combined the advantages of each of the others. It differs from Bergman's in having a joint at the bulb, where the moisture is condensed, as in the following:—

Fig. 4.

In spite, however, of all these improvements, which render the instrument better adapted for the uses to which it is successfully applied, we are far from having drawn from it all the advantages to which we might attain were its employment not as fatiguing as it is difficult. We require no other proof of this than the small number of those who know well bow to make use of the blow-pipe. The following remarks may assist those who are desirous of learning the use of this really valuable adjunct to chemical manipulation; and, as Mr. Mawe says, "perhaps no general caution can be more essential than to advise the operator *not to work too hard*, as the most efficacious flame is produced by a regular moderate stream of air, while the act of blowing with more force has only the effect of fatiguing the muscles of the cheeks, oppressing the chest, and, at the same time, renders the flame unsteady." First accustom yourself to hold the mouth full of air, and to keep the cheeks well inflated, during a pretty long series of alternate inspirations and expirations; then seizing lightly with the lips the mouth of the blow-pipe, suffer the air compressed by the muscles of the cheeks, which act the part of a bellows, to escape by the beak of the blow-pipe, which you will be able to do without being put to the least inconvenience with regard to respiration. When the air contained in the mouth is pretty nearly expended, you must take advantage of an inspiration to inflate the lungs afresh, and thus the operation is continued. You must never blow through the tube by means of the lungs. First, because air which has been in the longs is less proper for combustion than that which has merely passed through the nose and mouth; secondly, because the effort which it would be necessary to make to sustain the blast for only a short time, would, by its frequent repetition, become very injurious to the health.

The best flame for the purpose of this intrument is that of a thick wax candle, (such as are made for the lamps of carriages) the wick being snuffed off such a length as to occasion a strong combustion, it should be deflected a little to one side, and the current of air directed along its surface towards the point; a well defined cone will be produced, consisting of an external yellow, and an internal blue flame: at the point of the former, calcination, the oxidation of metals, roasting of ores to expel the sulphur, and other volatile ingredients may be accomplished; and by the extreme point of the latter, (which affords the most intense heat,) fusion, the deoxidation of metals, and all those operations which require the highest temperature, will be effected. The piece of mineral to be examined must necessarily be supported on some substance; and, for the earths, or any subject not being metallic, or requiring the operation of a flux, a spoon or pair of forceps, made of platina will be found useful; but as the metals and most of the fluxes act on platina, the most servicable support, for general purposes, will be a piece of sound well-burnt charcoal, with the bark scraped off, or free as possible from knots or cracks; the piece of mineral to be examined should not in general be larger than a pepper-corn, which should be placed in a hollow made in the charcoal, and the first impression of the heat should be very gentle, as the sudden application of a high temperature is extremely liable to destroy those effects which it is most material to observe. Many substances decrepitate immediately they become hot, and when that is found to be the case, they should be heated red, under circumstances which will prevent their escape; this may be effected with the earthy minerals by wrapping them in a piece of platina foil, and with the metallic ores by confining them between two pieces of charcoal, driving the point of the flame through a small groove towards the place where the mineral is fixed, by which means a sort of reverberating furnace may be formed. The principal phenomena to be noticed are phosphorescence, ebullition, intumescence, the exhalation of vapors, having the odour either of sulphur or garlic, (the latter arising from the presence of arsenic,) decrepitation, fusibility, and amongst the fusible minerals, whether the produce is a transparent glass, an opaque enamel, or a bead of metal.

Having first made some observations on a particle of the mineral alone, either the residue or a fresh piece should be examined with the addition of a flux, more particularly in the case of the ores, as the nature of the metal may be generally decided by the color with which it tinges the substances used. The most eligible flux is glass or borax; a piece, about half the size of a pea being placed on the charcoal, is to be heated till it melts; the particle of ore, being then taken in a pair of forceps, is to pressed down in it and the heat applied; or should the mineral not be inclined to decrepitate, it may be laid on the charcoal, and two or three pieces of glass of borax, about the size of a pin's head, placed over it, and on using the blow-pipe the whole will form itself into a globular bead.

It would be advisable for the learner to commence with a piece of common lead ore, which should be placed in the hollow of the charcoal, (see Fig. 1;) and after having first submitted it to the yellow flame, in order to drive off the sulphur, it may be brought within the action of the blue flame, when it will instantly melt into a bead of lead, the charcoal at the same time being colored yellow. He may then proceed with the following metals.

White Lead Ore.—Apply the flame gently as before, and the mineral will exhibit an orange or red color, and afterwards melt into small globules.

Silver.—A particle melts into a brilliant ball, which on cooling becomes dead white. Silver ores, if not very poor, will discover a bead of silver by repeated melting with or without borax.

Copper Ores, except they are very poor, may be easily melted into a bead of copper, or detected by nitric acid.

Pyrites, is subject to decrepitate, therefore requires the heat to be very delicately applied. The sulphur will then evaporate, and leave a scoria of iron which is attracted by the magnet.

It would far exceed the limits necessarily assigned to this slight sketch, to point out the various effects produced by the several metallic and earthy minerals when acted upon by the blow-pipe. Having put the student into the way of using it, we may hope, with some confidence, thet the examination of

few specimens, by means of the test and blow-pipe, will excite a degree of interest which will lead to the further pursuit of studies, in which he must avail himself of the assistance to be derived from experience and more extensive works, though we shall have somewhat to say relative to the application of the usual tests in a future number.

Our present weeks's frontispiece represents a person using a small blow-pipe, and surrounded by the apparatus necessary for mineralogical chemistry. Upon the table will be seen an electrometer, balanced upon a point; a magnet capable of being similarly supended; a horse-shoe magnet; pestle and mortar; test tubes; evaporating dishes; a mineralogical hammer; magnifying glasses; box of chemical ingredients, &c.—all of which are necessary in analytical operations.

INSECTS.

(Resumed from page 143, and concluded.)

Minute Moths.—Much experience and considerable care, with a light, but steady hand, are necessary for the management of minute moths on the setting wood; it will be equally useless and impossible, to enter into a minute detail of every trivial circumstance that must be attended to; we shall therefore give a general sketch, and leave the rest to the ingenuity of the operator.

First, the fans of the clappers, or forceps, or the fowling-net if you prefer it, must be covered with silk gauze of a very soft and delicate texture, and as the slightest friction will obliterate the beautiful speckings, or raised tufts that are so profusely bestowed by the hand of nature on this most elegant tribe of insects, you must be extremely careful when you press on the thorax not to crush it more than you can possibly avoid; or if you have it between the fangs of the forceps, put the pin through the thorax while the creature is confined in that situation.

The next care will be to procure pins of such a degree of fineness, as not to injure or distort the wings of the insect; the smallest sort of lace pins will do very well for most kinds, but there are some so extremely minute that even those would be too coarse. If you have pins made purposely for insects of this kind, let them be about an inch in length, and have them drawn as fine as possible.

When the pin is put through the thorax it must be managed with the greatest dexterity, and be exactly in the centre, as the least variation to either side will break the nerves of the anterior margin of the upper wings, which will immediately start, and can never be replaced in a proper position; if the pin be placed too high, it will sever the head from the shoulders; and by being too low the under wings also will break off or start from their true position; it may be managed better with the assistance of a magnifying eye-glass.

The braces are to be made of the same form as those which are used for larger insects, only smaller in proportion; and instead of making them of stiff card, or pasteboard, they may be of stout paper that has been hot-pressed. You must brace them immediately after you have put the pin through the thorax, for if they are permitted to stiffen, they cannot be relaxed so well as larger insects.

Minute moths are to be found in winter as well as summer; it would scarcely be imagined, nay reason would deny, did not experience prove, that when the frost is so severe as to entirely subvert the appearance, and almost annihilate the existence of all the vegetable productions, within the verge of its influence, myriads of these delicately-formed creatures brave the inclement season, and exist securely within those habitations they have the address to construct.

A very skilful entomologist informs us that having occasion to go into the country when the cold was intensely severe and the snow deep, he collected in a few hours a vast number of minute insects of the *Coleoptera Hemiptera*, and *Lepidoptera* orders; and though his collection was then very considerable he selected thirteen new species, and among them several which he has never found, but when the weather has been very cold, as at that time.

It is proper to observe, that those insects usually shelter among the moss, and other extraneous matter that grow on the trunks or branches of trees, or beneath the rotten bark. Gather the moss, &c. into a box or tin canister, and shut it close to prevent the escape of those insects, that may revive by the warmth; when you have an opportunity to examine them, spread a sheet of writing paper on the table, and place a lamp, or candle, with a shade of transparent, or oil paper before you, so as to weaken the glare; then separate the moss, and shake it loosely in your hand, and you will perceive many insects fall down on the paper; if they are so minute that by thrusting the pin through the thorax they would be damaged, fasten them with gum water or some glutinous varnish, to small slips or pieces of paper.

Neuropterous, Hymenopterous, and Dipterous Insects.—Among those of the *Neuropterous* order are included the *Libellulæ*, or Dragon Flies, a most elegant tribe of insects, but very difficult to preserve. The colors on the body are exceedingly brilliant in some species, but inevitably black within a few days after death, unless the collector is particularly attentive to their preparation.

They are extremely tenacious of life; we have seen one of the larger kinds live two days on the pin, and even show symptoms of life twenty-four hours after being deprived of its head.

The most expeditious method of killing those creatures, is to run a red-hot wire up the body and thorax, for they will live a considerable time in agony if you attempt to kill them with aquafortis as directed before for the moth tribe.

After they are dead, clean their bodies on the inside with a little cotton twisted to the end of a wire, and put a roll of white paper into the cavity, or fill it with cotton; and in most species this will not only admirably relieve the colors, but preserve them from changing into black.

Note.—Those kinds only with transparent skins will require this preparation, as the *L. 4. maculata.*

Some of the foreign insects of those orders appear to the greatest advantage in spirit of wine, but whenever the usual method will suffice, it should be preferred. They are all to be stuck through the thorax, and observe always to put the pin so far through, that when it is stuck near a quarter of an inch into the cork the feet of the insect may only touch the surface.

The wings are to be displayed with cramps as usual.

Apterous Insects.—Many kinds may be preserved in spirits or in the same manner as *Coleopterous* and other insects; but among these we can include very few, if any, of that extensive genus *Aranea* (spiders,) no method having been hitherto discovered

whereby they may be preserved in their natural colors, for however beautiful they may be when alive, their bodies shrivel and their tints become an obscure brown, soon after death; and as the moisture exhales, the size of the body diminishes, very little more than the skin of it remaining when the creature is sufficiently dry to be placed in the cabinet.

Spiders cast their skins several times in the course of their lives; the exuviæ would be very acceptable to the collector, if they retained any of the beautiful colors of the living spiders.

To determine whether some species of spiders could be preserved with their natural colors, several were put into spirits of wine; those with gibbous bodies soon after discharged a considerable quantity of viscid matter, and therewith all their most beautiful colors; the smallest retained their form, and only appeared rather paler in the colors than when they were living.

From observations it is found, that if you kill the spider, and immediately after extract the entrails, then inflate them by means of a blow-pipe, you may preserve them tolerably; you may cleanse them on the inside no more than is sufficient to prevent mouldiness, lest you injure the colors, which certainly in many kinds depend on some substance that lies beneath the skin.

After inflating them, you may either inject them with fine virgin wax, or anoint the skin with oil of spike in which resin has been dissolved, and dry them in some shady place.

SPONTANEOUS DECOLORATION OF TINCTURE OF LITMUS.

BY M. VOGEL.

It frequently happens that the tincture of litmus prepared with boiling water loses its bright color entirely after a time, and becomes of a bright brown, or wine yellow color.

This decoloration occurs especially when the tincture has been left for several months undisturbed, and well stopped in bottles which are not completely full: with alcohol the tincture decolorates more slowly than without it, and the decoloration is especially favored where a quantity of several pounds is kept in a bottle.

The tincture thus become yellow, is not spoiled by the change, nor is it unfit for use, for its original color may be made to re-appear in several modes: first, by exposing it to the air, or by agitating it in a bottle with air. Its color re-appears also when heated to 122° Fahr. in a receiver over mercury, provided some air be present in the receiver.

Although it appears probable that the tincture which has been spontaneously decolorated, becomes again blue by the deoxidation of the air (for it forms at first a blue ring on the surface of the liquid,) it requires, however so small a quantity of oxygen, that I could scarcely perceive any diminution in the volume of the air, whilst it regained its color.

As the litmus of commerce contains a trace of animal matter, I presumed at first that the decoloration was excited by the decomposition of this animal substance, and that carbonate of ammonia was formed; but experiment did not confirm this suspicion, for on heating the tincture, which had become spontaneously yellow, in a matrass furnished with a bent tube, neither ammonia nor carbonic acid was evolved, although the liquid became again blue by the increase of temperature.

As the litmus of commerce almost always contains sulphate of potash also, it appeared to me possible, and even probable, that if this salt were decomposed, the decoloration might be the result of it. I ascertained the presence of sulphate of potash in the litmus on which my experiments were made, in the following manner: I added chloride of barium to the tincture made with boiling water; it formed an abundant blue precipitate, and the liquor was entirely decolorated at the expiration of 24 hours.

The washed precipitate was of a deep blue color, and it had in part the properties of a compound of the blue color of the litmus with barytes. To examine whether the dried precipitate contained any barytes, it was heated to redness in a platina crucible, and moistened with hydrochloric acid, which disengaged sulphuretted hydrogen gas. Besides this, I evaporated the tincture of litmus to dryness, and then heated the residue to redness; the ashes, besides carbonate of potash and chloride of potassium, contained some sulphate of potash.

The gradual decomposition of sulphate of potash by the organic matter and especially the sulphuretted hydrogen which results from it, appears then to be the principal cause of the decoloration of the tincture of litmus; nevertheless, as in pursuing these experiments I did not discover the presence of sulphuretted hydrogen in the decolorated tincture, by employing paper moistened with acetate of lead, I became uncertain whether the decoloration was really effected by sulphuretted hydrogen. As however a few drops of an aqueous solution of sulphuretted hydrogen, added to a large quantity of the blue tincture, well stopped in a bottle, were sufficient to decolorate it in a few days, and as I could not discover in the tincture thus decolorated, any sulphuretted hydrogen, it having been decomposed, I had no longer any doubt that the blue color of the tincture was destroyed, under all circumstances, by the sulphuretted hydrogen which is insensibly formed; thus taking away a part of the oxygen which it afterwards absorbs from the air, and its blue color returns. After what has been stated, it was impossible to prove the presence of sulphuretted hydrogen in the decolorated tincture, because it is decomposed immediately after its formation.

The decoloration of the tincture of litmus by means of a few drops of solution of sulphuretted hydrogen, and the recovery of its blue color by the contact of air may be repeated a great number of times, without the tincture seeming to undergo any sensible change. When a small quantity of sulphate of lime or sulphate of soda is dissolved in the tincture of litmus, the decoloration begins sooner than with the sulphate of potash which exists in the tincture. Brasilin dissolved in water and stopped in a bottle with sulphuretted hydrogen is also decolorated, but hematin requires a long time for the production of this effect; and the infusion of the leaves of the *Delphinium Ajacis* does not undergo any sensible change by sulphuretted hydrogen, even after the lapse of several weeks.—*Journal de Pharm.*

RAILWAYS.

Railways are roads made by placing lines of smooth and parallel bars between one place and another in order to increase the speed of the transport of carriages by diminishing the resistance to the rolling of the wheels. The most perfect of the Roman roads, as the Appian way, which is a continued plane surface formed by blocks of stone closely

fitted together, was a near approach to the modern railroad; but the plans of the two species of road are very different. The first railways, formed on the plan of making a distinct surface and tract for the wheels, seem to have been constructed near Newcastle-upon-Tyne. In Roger North's Life of Lord Keeper North, he says that at this place, (1676) the coals were conveyed from the mines to the bank of the river, "by laying rails of timber exactly straight and parallel; and bulky carts were made with four rollers fitting those rails, whereby the carriage was made so easy that one horse would draw four or five chaldrons of coal." One hundred years afterwards, viz., about 1776, Mr. Carr constructed an iron railroad at the Sheffield colliery. The rails were supported by wooden sleepers, to which they were nailed. In 1797 Mr. Barns adopted stone supports in a railroad leading from the Lawson main colliery to the Tyne near to Newcastle; and, in 1800, Mr. Outram made use of them in a railroad at Little Eaton, in Derbyshire. Twenty-five years afterwards, this species of road was successfully adopted on a public thoroughfare for the transportation of merchandise and passengers, viz. the Stockton and Darlington railroad, which was completed in 1825, and was the first on which this experiment was made with success. From that time, accordingly, a new era commenced in the history of inland transportation.

The species of rail first employed was a broad surface of cast iron, sufficient to support the rim of a common cart or carriage; these are called plate or *tram* rails, and such rails are very useful, where the carriages that pass over them have occasionally to traverse common roads. But another species of rail is now universally employed, where the carriages have to pass only over the railway; they are called *edge* rails, and are distinguished from the former by being much narrower on the upper surface. On the edge railway very narrow wheels are used on the carriages, the breadth of the rail not in general exceeding two inches, and the carriage is kept on the way by means of flanges on the outer part of the rim of the wheel. The rails are fashioned in bars commonly three feet in length, fastened at each end upon sleepers. The usual form of such is of the fish-bellied shape, thicker in the middle than at the ends, but although theoretically this may appear the best fitted for the purpose, recent experience has shown that a straight rail is equally strong, and has this great advantage, that the cost is much less, from the greater ease in making. Cast iron rails are at first much cheaper than malleable iron ones, but the following statement will show that the latter are, in reality, by much the more economical:—

"Malleable iron rails, 15 feet long, over which 86,000 tons have passed in a year; weight of rails, 4 cwt. 21½ lbs. Loss of weight in twelve months, 8oz.—Cast iron rails, 4 feet long, over which 86,000 tons has passed in a year; weight of rail, 63 lbs. Loss of weight in twelve months, 8 oz., being as great a loss upon 4 feet of cast as upon 15 feet of wrought iron rails."

Not only are malleable rails more durable than those made of cast iron, but malleable rails when in use are less susceptible to the deteriorating action of the atmosphere than the same rails would be if unused; for if a bar of wrought iron be placed upon the ground, alongside of one of the same form and material in the railway use, the former is continually throwing off scales of rust, while the latter continues almost wholly free from waste of that description, a fact discovered by Mr. Stephenson to depend on certain electric influences communicated by the passage of the trains. The strength of iron necessary for the construction of a permanent railway is a matter which can be decided only by experience. Unless the railroad be supported equally throughout its entire length, each rail must be subject to some amount of defection when great weights are passing over it, and the extent of the deflection is in some measure dependent also upon the speed, and in the opinion of Professor Barlow, the additional resistance to the carriages, caused by the deflection of the bar, will be equivalent to the carriage being carried up a plane of half the whole length, the other half being horizontal. The rails first employed on the Liverpool and Manchester railway weighed no more than 35lbs. per yard, but were soon found to be inadequate to the purpose. In the report of the Directors of the Railway Company, made in January, 1834, they state, "in particular parts of the road, especially on the descending lines of the inclined planes, the rails prove too weak for the heavy engines, and the great speed at which they are moved; and from the breakages which have taken place, the directors have though it expedient to order a supply of stronger and heavier rails to be put down in those districts where the present rails have been found insufficient." In their report of July, 1837, they state, that, "with the plan recommended by the directors at the last half-yearly meeting, of relaying from time to time certain portions of the road with heavier and stronger rails, the directors have every reason to be satisfied. A portion of the way has been recently laid with parallel rails, 60lbs to the yard; and when in addition to the greater security afforded to the general traffic by a firm and substantial rail, account is taken of the diminished charge at which the road, when so laid, will be kept in order, the directors feel confident that the proprietors will approve of their persevering in the plan which they have thus commenced." This is only one instance out of many in which the Liverpool and Manchester Company have been constrained to purchase experience at a very dear rate—dear, at least if regarded in reference to their individual and pecuniary interests, but cheap, if the proprietors, taking a more enlarged view of the great subject of railways, will include in their consideration the beneficial results, vast and undisputed, which will shortly be realized by the country and the world. Mr. Brunel, the engineer of the Great Western railway, has suggested that a greater space should be allowed between the rails than has been adopted on the Liverpool and Manchester, or London and Birmingham railways, and the carriages being hung between the wheels, the diameter of the wheels can be increased, and with it the speed of travelling.

(Continued on page 181.)

PRINCIPLE OF THE DAGUERROTYPE.

Paris, August 21st.

I WRITE to you to report,—though of necessity hastily;—the proceedings of the *Academie de Sciences* of Monday last, when M. Arago, in the presence of a crowded audience, which had besieged the doors of the Institute three hours before the commencement of the sitting, divulged the secret of M. Daguerre's invention, which has now as you are aware, become public property. Three drawings having been exhibited, by way of specimens, M. Arago began by

recapitulating the discoveries, or rather hints towards discoveries of former chemists: he afterwards dwelt upon the progressive experiments of M. Niepce, since carried out by M. Daguerre. As, however, your columns already contain notices of these, I will come at once to the publication of the secret of the perfect invention, and in order to give you this as fully and clearly as possible, I send you an abstract from the report published in yesterday's *Journal des Debats.*

M. Arago stated that, according to M. Daguerre's process, copper plated with silver is washed with a solution of nitric acid, for the purpose of cleansing its surface, and especially to remove the minute traces of copper, which the layer of silver may contain. This washing must be done with the greatest care, attention, and regularity. M. Daguerre has observed, that better results are obtained from copper plated with silver, than from pure silver; whence it may be surmised, that electricity may be concerned in the action.

After this preliminary preparation, the metallic plate is exposed, in a well-closed box, to the action of the vapour of iodine, with certain precautions. A small quantity of iodine is placed at the bottom of the box, with a thin gauze between it and the plate, as it were, to sift the vapour, and to diffuse it equally. It is also necessary to surround the plate with a small metallic frame, to prevent the vapour of iodine from condensing in larger quantities round the margin than in the centre; the whole success of the operation depending on the perfect uniformity of the layer of ioduret of silver thus formed. The exact time to withdraw the sheet of plated copper from the vapour, is indicated by the plate assuming a yellow color. M. Dumas, who has endeavoured to ascertain the thickness of this deposit, states that it cannot be more than the millionth part of a *millimetre.* The plate thus prepared, is placed in the dark chamber of the camera obscura, and preserved with great care from the faintest action of light. It is, in fact, so sensitive, that exposure for a tenth of a second is more than sufficient to make an impression on it.

At the bottom of the dark chamber, which M. Daguerre has reduced to small dimensions, is a plate of ground glass, which advances or recedes until the image of the object to be represented is perfectly clear and distinct. When this is gained, the prepared plate is substituted for the ground glass, and receives the impression of the object. The effect is produced in a very short time. When the metallic plate is withdrawn, the impression is hardly to be seen, the action of a second vapour being necessary to bring it out distinctly: the vapour of mercury is employed for this purpose. It is remarkable, that the metallic plate, to be properly acted upon by the mercurial vapour, must be placed at a certain angle. To this end, it is inclosed in a third box, at the bottom of which is placed a small dish filled with mercury. If the picture is to be viewed in a vertical position, as is usually the case with engravings, it must receive the vapour of mercury at an angle of about 45°. If, on the contrary, it is to be viewed at that angle, the plate must be arranged in the box in a horizontal position. The volatilization of the mercury must be assisted by a temperature of 60° (of Reaumur).

After these three operations, for the completion of the process, the plate must be plunged into a solution of hypo-sulphite of soda. This solution acts most strongly on the parts which have been uninfluenced by light; the reverse of the mercurial vapour, which attacks exclusively that portion which has been acted on by the rays of light. From this it might perhaps be imagined, that the lights are formed by the amalgamation of the silver with mercury, and the shadows by the sulphuret of silver formed by the hypo-sulphite. M. Arago, however, formally declared the positive inability of the combined wisdom of physical, chemical, and optical science, to offer any theory of these delicate and complicated operations, which might be even tolerably rational and satisfactory.

The picture now produced is washed in distilled water, to give it that stability which is necessary to its bearing exposure to light without undergoing any further change.

After his statement of the details of M. Daguerre's discovery, M. Arago proceeded to speculate upon the improvements of which this beautiful application of optics was capable. He adverted to M. Daguerre's hopes of discovering some further method of fixing not merely the images of things, but also of their colors: a hope based upon the fact, that, in the experiments which have been made with the solar spectrum blue color has been seen to result from blue rays, orange color from orange, and so with the others, Sir John Herschel is sure that the red ray alone is without action. The question arose, too, whether it will be possible to take portraits by this method? M. Arago was disposed to answer in the affirmative. A serious difficulty, however, presented itself;—entire absence of motion on the part of the object is essential to the success of the operation, and this is impossible to be obtained from any face exposed to the influence of so intense a light. M. Daguerre, however, believes that the interposition of a blue glass would in no way interfere with the action of the light on the prepared plate, while it would protect the sitter sufficiently from the action of the light. The head could be easily fixed by means of supporting apparatus. Another more important desideratum is, the means of rendering the picture unalterable by friction. The substance of the pictures executed by the Daguerrotype is in fact, so little solid—is so slightly deposited on the surface of the metallic plate, that the least friction destroys it, like a drawing in chalk: at present, it is necessary to cover it with glass.

From his numerous experiments on the action of light on different substances, M. Daguerre has drawn the conclusion that the sun is not equally powerful at all times of the day, even at those instants when his height is the same above the horizon. Thus, more satisfactory results are obtained at six in the morning than at six in the afternoon. From this, too, it is evident, that the Daguerrotype is an instrument of exquisite sensibility for measuring the different intensities of light, a subject which has hitherto been one of the most difficult problems in Natural Philosophy. It is easy enough to measure the difference in intensity between two lights viewed simultaneously, but when it is desired to compare daylight with a light produced in the night—that of the sun with that of the moon, for example—the results obtained have had no precision. The preparation of M. Daguerre is influenced even by the light of the moon, to which all the preparations hitherto tried were insensible, even when the rays were concentrated by a powerful lens.

In physics, M Arago indicated some of the more immediate applications of the Daguerrotype, independently of those which he had already mentioned Photometry. He instanced some of the most

complex phenomena exhibited by the solar spectrum. We know, for example, that the different colored rays are separated by black tranversal lines, indicating the absence of these rays at certain parts; and the question arises whether there are also similar interruptions in the continuity of the chemical rays? M. Arago proposes, as a simple solution of this question, to expose one of M. Daguerre's prepared plates to the action of a spectrum; an experiment which would prove whether the action of these rays is continuous or interrupted by blank spaces.

I shall only add, that M. Daguerre has entered into a contract with Giroux, the celebrated toyman, for the practical application of his discovery—and that it is said he has already *in petto*, some new results of importance, which he will submit to the *Academie* at an early opportunity.—*From a Correspondent of the Athenæum.*

CONCRETE.

Concrete is the name given by architects to a compact mass of pebbles, sand, and lime cemented together, in order to form the foundations of buildings. Semple says that the best proportions are 80 parts of pebbles, each about 7 or 8 ounces in weight, 40 parts sharp river sand, and 10 of good lime, the last is to be mixed with water to a thinnish consistence, and grouted in. It has been found that Thames ballast, as taken from the bed of the river, consists nearly of 2 parts of pebbles to 1 of sand, and therefore answers exceedingly well for making concrete; with from one-seventh to one-eight part of lime. The best mode of making concrete, according to Mr. Godwin, is to mix the lime, previously ground, with the ballast in a dry state; sufficient water is now thrown over it to effect a perfect mixture, after which it should be turned over at least twice with shovels, or oftener; then put into barrows, and wheeled away for use instantly. It is generally found advisable to employ two sets of men to perform this operation, with three in each set; one man to fetch the water, &c., while the other two turn over the mixture to the second set, and they, repeating the process, turn over the concrete to the barrow-men. After being put into the barrows, it should at once be wheeled up planks, so raised as to give it a fall of some yards, and thrown into the foundation, by which means the particles are driven closer together, and greater solidity is given to the whole mass. Soon after being thrown in, the mixture is observed usually to be in commotion, and much heat is evolved with a copious emission of vapour. Tha barrow-load of concrete in the fall spreading over the ground, will form generally a stratum of from 7 to 9 inches thick, which should be allowed to set before throwing in a second.

Another mode of making concrete, is first to cover the foundation with a certain quantity of water, and then to throw in the dry mixture of ballast and lime. It is next turned and levelled with shovels; after which more water is pumped in, and the operation is repeated.—Tha former method is undoubtedly preferable.

In some cases it has been found necessary to mix the ingredients in a pug-mill, as in mixing clay, &c. for bricks. For the preparation of a concrete foundation, as the hardening should be rapid, no more water should be used than is absolutely necessary to effect a perfect mixture of tha ingredients. Hot water accelerates the induration. There is about one-fifth of contraction in volume in the concrete, in reference to the bulk of its ingredients. To from a cubical yard of concrete, about 30 feet cube of ballast and 3½ feet cube of ground lime must be employed, with a sufficient quantity of water.

NEW WRITING FLUID.

In looking over the thousand and one receipts for writing ink, one might imagine the projectors had belaboured to introduce as much extractive matter as possible, in order to make a liquid mud for the purpose of writing, so heterrogeneous and unnecessary are the substances introduced, clearly showing the subject never to have been scientifically understood. All that we are given to understand is, that the copperas and galls form a tanno-gallate of iron, which is suspended in the liquid by gum arabic, but I will show that the tanno-gallate does not precipitate, which is fatal to the above theory, and leaves the field open for another, which I will venture to propound.

When sulphate of iron is added to infusion (or decoction) of galls, the oxide of iron exercises an elective affinity for the tanno-gallic acid, while tha sulphuric acid is left free which combining with another portion of sulphate froms bi-sulphate of iron, which absorbing oxygen from the atmosphere is converted into persulphate, and forms with the tanno-gallate, what may be termed the insoluble *persulphated tanno-gallate of iron*, which suspended by means of gum arabic forms the basis of common writing ink; it is rendered colorless by most acids, gets rusty by age, clogs the pen, turns mouldy, and is by no means clean in its manufacture. In contradistinction to which I have found the following receipt superior. Taka half a pint of infusion of galls and one drachm of camphor, a piece of clean iron wire of a spiral form, to present a surface of the length of the bottle, and inserted in the cork; introduce the whole into a half pint bottle, and let it stand for a month. The infusion is one part galls to eight of water. In this fluid there is no free mineral acid, there being simply tanno-gallate of iron for the basis; the iron decomposes the water and becomes oxidised in the usual manner, consequently there can be no excess of iron in the fluid to give it a rusty appearance. The tanno-gallste, not being a precipitate, requires no mucilage for its suspension, neither is it obliterated by dilute acids, and alkalies only give it a deep brown color, the camphor prevents mouldiness.

Thus is an ink made, clean, economical, indelible, and limpid; made in fact with no more trouble than a cup of tea. No one will, ever think of the old receipts for *black mud* after having tried tha above. I have used it for the last three months, and for which I claim no originality, as the accidental overthrow of some strong tea on a knife first gave rise to the idea. J. Cooke.

[The color of the writing in our correspondent's letter is certainly good, and appears to have flowed readily from the pen. We have also tested it by the acetic, nitric, sulphuric, and muriatic acids, which do not appear to affect the color, unless in a sufficiently concentrated state to injure tha textura of the paper also. The receipt above we have no doubt will make a good ink, but it is not new, except indeed as a general writing fluid. It is customary for leather dressers, dyers, and wood stainers, to use a liquid formed by pouring a decoction of

logwood shavings upon the rust of iron, which it will be seen is analogous in principle to the foregoing. The process of making this dye was, however, but little understood, (at least in London,) until about forty years ago, when an individual established a manufactory in Whitechapel, to supply the dyers, &c., with what is called *iron liquor*, which was made simply by soaking old iron hoops in water: and although he sold the liquor when prepared at a few pence only per gallon, he realized a very large fortune.

In the receipt of our correspondent surely there is a mistake in the quantity of camphor. This resin being, in a very small degree, soluble in water. One grain of corrosive sublimate, or one drop of creosote, will prevent mould in a gallon of ink.—Ed.]

MISCELLANIES.

To choose Copper for Engraving.—Plates intended for engraving ought to be of the best copper, which should be very malleable, firm, and with some degree of hardness, free from veins or specks, or dissimilar parts. The redness of copper is a presumptive mark of its being good, but not an infallible one; for though it is, in general, a proof of the purity of the copper, yet it does not evince that the quantities may not be injured by too frequent infusion.

Copper-plates may be had ready prepared in most large towns; but when these cannot be had, procure a pretty thick sheet of copper, rather larger than the drawing, and let the brazier planish it well; then take a piece of pumice-stone, and with water rub it all one way, till it becomes tolerably smooth and level; a piece of charcoal is next used with water for polishing it still farther, and removing the deep scratches made by the pumice-stone, and it is then finished with a piece of charcoal of a finer grain, with a little oil.

To Copy Writings.—Take a piece of unsized paper exactly of the size of the paper to be copied; moisten it with water, or with the following liquid: Take of distilled vinegar, two pounds weight, dissolve it in one ounce of boracic acid; then take four ounces of oyster shells calcined to whiteness, and carefully freed from their brown crust; put them into the vinegar, shake the mixture frequently for 24 hours, then let it stand till it deposits its sediment; filter the clear part through unsized paper into a glass vessel; then add two ounces of the best Aleppo galls bruised, and place the liquor in a warm place; shake it frequently for 24 hours; then filter the liquor again through unsized paper, and add to it, after filtration, one quart of pure water. It must then stand 24 hours, and be filtered again, if it shows a disposition to deposit any sediment, which it generally does. When paper has been wet with this liquid, put it between two thick unsized papers to absorb the superfluous moisture; then lay it over the writing to be copied, and put a piece of clean writing paper above it. Put the whole on the board of a rolling press, and press them through the rolls, as is done in printing copper plates, and a copy of the writing will appear on both sides of the thin moistened paper; on one side in a reversed order and direction, but on the other side in the natural order and direction of the lines. "

ANSWERS TO QUERIES.

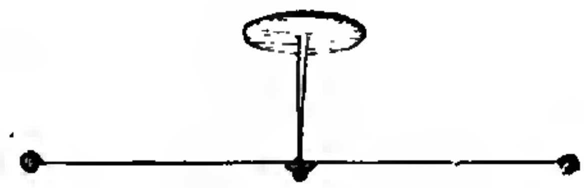
87—*What occasions the whistling sounds of volant bodies?* When bodies move quickly a partial vacuum is caused, and the noise is produced by the air returning to its place.

89—*Two balls, each of one pound weight, suspended on separate strings, contiguous but not touching, showing no inclination to coalesce—at what height from the earth's surface would they manifest attraction for each other?* The question is not sufficiently explicit for a direct answer, because it would be requisite to ascertain the comparative *weight* of the earth; also the space signified by *contiguous* is indefinite. The following general method of solution is therefore all that can be given:—Supposing the balls to be of equal *density* with the earth; then, as the sum of the squares of the diameters of each ball, is the square of the diameter of the earth, so is the square of the distance of the balls from each other to the square of the distance of each ball from the earth. If they are of different density, then the density of the balls is to the density of the earth—as the square of the distance thus found to the square of the distance they should be at to make the attractive forces *balance*; consequently, a slight addition will give the distance at which the balls will attract each other.

100—*Is there any point in the mandril of a lathe which remains stationary while the mandril revolves?* No, certainly not. Mathematically the centre of the axis is at rest, but practically it moves with the rest of the mandril.

101—*What is the principle of the quicksilver boats?* The "Cygnet" London and Westminster quicksilver boat is, or was, on Mr. Howard's principle, and has no boiler, but the following substitute for one:—A quantity of mercury is placed in a wrought-iron vessel, over a coke fire, and maintained at a temperature of from 4° to 600° Fah. the foot, per horse power. The upper surface of the mercury is covered by a thin plate of iron, which rests in contact with it, and is so constructed as to present about four times the surface that is exposed to the fire. Adjoining this is a vessel, containing water heated to nearly the boiling point, and communicating with it by means of a nozzle and valve; and the water is from time to time injected by the engine, in small portions, to the top iron plate, from which it receives the heat, not only necessary to convert it into steam, but also to expand steam, being above what it would receive if in contact with water, the temperature being above its pressure; hence the steam passes into a jacket surrounding the cylinder, which jacket is also surrounded by another, forming the passage of the heated air to the funnel, by which means the temperature is preserved at 400°, the pressure being 25lbs. per inch. The arrangement of the slide valves is such that the steam acts expansively. The conductor is a copper vessel immersed in a cistern of cold water, and the steam flows into it by the eduction pipe in the usual manner, and a jet is admitted to it from an adjoining vessel, filled before working with distilled water, and the condensed water, and the condensed steam, are pumped therefrom into a copper worm placed in a cistern of cold water, by which means they are reduced in temperature, and then re-conducted to the distilled water tank. The fire is urged by a blowing machine.—*Dr. Lardner.*

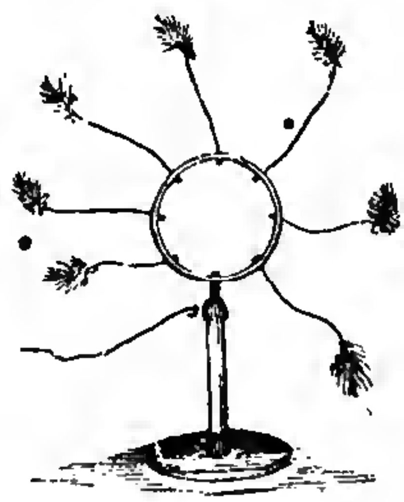
Fig. 1.



2.

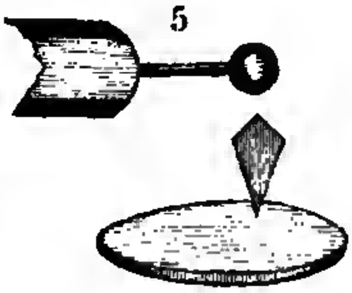
3.

4.



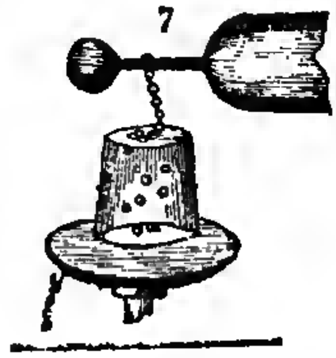
ELECTRICAL ATTRACTION AND REPULSION.

5

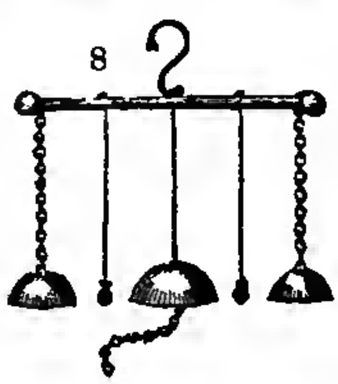


6

7



8



ELECTRICITY.

Resumed from page 167.

In all the numerous experiments, already introduced in these various numbers, the effect visible has mostly been that of a certain tendency the excited bodies have had to coalesce with each other in some cases, and to recede in others, or have been instances of electrical attraction and repulsion. Upon a closer examination of the circumstances attending these experiments, it will be found that when two bodies are electrified equally, they will repel each other; and also that when one body only is electrified, it is attracted by all others of a conducting nature in its neighbourhood. Thus it appears that two laws only govern all these phenomena, which Franklin gives thus:—The electric fluid repels itself, and attracts all other matter therefore, bodies similarly electrified, that is, if both are electrified *plus*, or both *minus*, they repel each other; but if one body be electrified *plus*, and the other *minus*, they will attract each other, until the equilibrium be restored, when they become neutral. It may be thought that, in many instances, but one body is affected, and therefore the laws do not apply. For example:—

Ex. 30.—Suspend from the ceiling a string, and from this a feather, attached to a thread of silk. Hold towards it an excited glass tube, the feather will first adhere to it, then be repelled, and, if a finger be held near it, be attracted towards the finger. The attraction of the feather and tube is accounted for—they are differently electrified. The receding of the feather is also accounted for—for after touching each other they are similarly electrified; but why the feather should seek the finger is not so apparent. It arises from a cause, which, instead of militating against the truth of Franklin's laws, does but prove their general applicability. When a body of any kind is electrified, it affects and repels the electric fluid contained in all the bodies near it, and thus the overcharged feather drives away some portion of the fluid in the finger, in consequence of which the part of the finger nearest to it becomes negative, or in a different state from itself—therefore they are mutually attracted. The degree of this attraction is found to be in proportion to the square of their approximation towards each other, or as it is usually expressed, proportional inversely as the square of their distance—that is, if at one inch distance from each other, they attract with a force equal to one—at two inches the attractive force will be a quarter as much only—at three inches it will be one-ninth only—that is, three times three. The cause of attraction we leave until a future chapter explains the laws of electrical induction. At present we content ourselves with laying before our readers some of the best of the numerous experiments on this particular division of electrical science.

Ex. 31.—Hang two feathers on silk strings from a stand, (Fig. 2,) which will elevate them some inches above the table, and which stand has a glass leg, or support, to it; or still better than this, hang a string from the ceiling, and at the end of the string the two silk lines with feathers, so that they are not near any other object. Hold towards the feathers the excited glass rod. The two feathers will, at first, adhere to the glass rod, and soon afterwards be repelled from it, and from each other.

Ex. 32.—Balance upon a rod of glass, terminated by a needle point, a delicate rod of wood, having a small disc of white paper, or a pith ball, at each end. Hold towards either end of this an excited glass rod—the end will be attracted by it. This forms a delicate, useful, and cheap electrometer (see Fig. 1.)

Ex. 33.—Procure two stands, each formed of a foot which supports a glass rod, and upon this a brass wire hooked at the top, so that there may be hung to it a silk thread, bearing at each end a feather, (as Fig. 2.) To the one pair of feathers hold an excited glass rod—they will repel each other with positive electricity. Hold towards the other pair of feathers an excited stick of sealing wax — they will repel each other with negative electricity. Put the one stand near the other, as represented in the figure, and the one pair will attract the other—they being differently electrified.

Note.—A common-sized stick of sealing wax is too small for this and similar experiments. The glass and sealing wax rods may be combined with advantage. Having procured a hollow glass tube, about two feet long and of one inch diameter, heat it gradually by a fire, until hot enough to melt sealing wax—then rub upon one half of it a stick of red wax, until the surface of that half is completely and evenly covered with the wax. Hold it near the fire again, that the wax may settle into a smooth and glossy surface, and it will be complete. When to be excited the glass end only will require warming, the waxed part serving as a handle; so also, when the waxed end is excited the glass may be held in the hand. To excite glass, rub it briskly with a black silk handkerchief—to excite sealing wax rub it with a piece of flannel.

Ex. 34.—Tie twenty fine linen threads together at each end, so that there may be about six inches distance from knot to knot, hang this by a wire loop fastened to one of the knots, to the conductor of the machine; upon charging the conductor, the threads will recede from each other forming a curious balloon-shaped body.

Ex. 35.—Instead of tying the threads at both ends, let the lower end be loose, and upon turning the machine, they will form a brush.

Ex. 36.—*The Glass Feather.*—Procure a glass feather, as made at the fancy glass shops, and stick it into one of the holes on the upper side of the conductor, when the machine is put in motion the radiation of all the filaments of glass will offer a most elegant object.

Ex. 37.—*The Frightened Head of Hair.*—As a variation of the last experiment, the head of a doll is furnished with a wig of hair which is two or three inches long; upon electrifying this "each particular hair will stand on end" in the most grotesque manner; and thus it is with every person who is electrified, when on a glass legged stool. This experiment becomes most effective because seen more conspicuously when the hair is of a grey color. (See Fig. 3.)

Ex. 38.—*Radiating Feathers.*—Let a metal ring be supported upon a glass pillar, and at six or eight equally-distant points, around this ring tie a thread (not silk) a few inches long, the other end of which bears a feather, (as in Fig. 4,) where six are represented. Connect the metal ring with the conductor of the machine by a wire or chain, and the feathers being electrified will repel each other until they will stand at equal distances like the spokes of a wheel.

Ex. 39.—*Electric Fish.*—Cut a piece of very thin leaf brass (such as is called tinsel will do) with

an obtuse angle at one end and an acute one at the other; present the large end towards an electrified conductor, and when the brass is within its atmosphere let it go; it will then fix itself to the conductor by the apex of its obtuse angle, and, from its continual wavering motion, will appear to be animated.

Ex. 40.—*Flying Feather.*—Excite a glass tube, (as in Experiment 33,) and hold towards it a very light and fleecy feather, it will adhere to it for a moment, then be repelled in the most beautifully expanded form; if no object be near, it will gradually be attracted to the earth, but it may be driven in any direction around the room, by bringing the still excited glass near it, for it will be still repelled from the glass. It is evident that the feather in sailing along must not be suffered to deposit its electricity by touching any surrounding object.

Ex. 41.—*Animated Thread.*—Present a fine thread to an electrified conductor, when it is at a proper distance it will fly towards, and stick to the conductor, and convey the electric fluid from it to the hand; remove the thread to a small distance from the conductor, and it will fly backwards and forwards with great velocity, and in a very pleasing manner; present the same thread towards one that hangs from the conductor, they will attract and join each other. Bring the finger, or a brass ball, near these threads, the ball will repel that held by the hand, and attract that which is affixed to the conductor.

Ex. 42.—*Suspended Leaf.*—Hold towards the ball at the end of the conductor, a square thin leaf of brass or paper; upon turning the machine, it will leave the hand and be suspended with one of its points upwards between the hand and the conductor. (See Fig. 5.)

Ex. 43.—*The Moving Leaf.*—Move the hand round, and at a uniform distance from the ball of the conductor, when the leaf of brass is suspended near it, and it will be seen to move with the hand in any direction which the latter may take.

Ex. 44.—*Dancing Images.*—To the end of the conductor, suspend a plate, made either of metal or wood, covered with tin foil, and at a distance of three or four inches under this a similar plate, but one that is rather larger. Place on the lower plate any little figures cut out of paper or pith. Take care that the lower plate is supported upon some conducting substance; turn the machine, and the figures will raise themselves, and fly up and down between the two plates, forming a most ludicrous dance. (See Fig. 6.)

Ex. 45.—Support the lower plate upon a glass bottle, or other insulator, and although all the rest of the apparatus remains as before, yet the figures will not dance. The reason is this, the upper plate being charged by its connection with the machine, the figures are attracted by it—they becoming charged are repelled by the upper, and attracted by the lower plate. When they touch this their charge is removed by that contact, and conveyed to the earth, while the figures jump up again, for a fresh supply, and thus they move alternately from the one to the other plate. When the lower plate, however, is insulated, the extra portion brought to it cannot escape, and it becomes charged in the same manner as the upper one—therefore, the figures have no tendency to move between them.

Note.—If in cutting out the figure the head is heavier than the feet, it will dance head downwards—damping the feet in the mouth will usually remedy this, but this, at the same time, gives them a tendency to adhere to the upper plate, while wetting the head makes them dance on the lower plate. Female figures usually dance more regularly because of the weight of the lower part of the dress. In all the figures the head should be somewhat pointed, either by the adjunct of a steeple-crowned hat, or something similar put upon it.

Ex. 46.—*Dancing Pith Balls.*—Place upon the lower stand, (mentioned in Experiment 44,) six or eight balls of the pith of elder, and cover them over with a dry tumbler. Hang to the conductor a chain, which touches this tumbler; upon turning the machine, although glass intervenes between the exciting power and the balls acted upon, yet the balls will fly rapidly up and down within the glass tumbler. In this instance, the outer part of the glass is by contact electrified positively; the inner part, therefore, will be by induction, (afterwards to be explained,) electrified negatively; and the balls are flying up and down to supply the deficiency of the glass—each ball coming to deposit its load, and flying down again for another. (See Fig. 7.)

Ex. 47.—The dancing pith ball experiment may be reversed thus:—Fasten to the conductor a chain as before. Put it in a dry tumbler, and turn the machine. After a few turns the tumbler will be charged withinside with positive electricity. Place upon a table, or a metal plate, a few pith balls, and cover them over with the charged tumbler. They will now jump up and down, each one conveying some of the fluid away from the glass, and not towards it as in the latter instance. They continue to dance long after the machine ceases to act, and when their motion has ceased altogether, it may be renewed by merely putting the hand upon the outside of the glass.

To make Pith and Cork Balls.—Procure some of the thick young shoots of the common elder-tree, cut them into lengths between the joints, and push out the pith of each length by a smooth stick, as near as possible the size of the hole where the pith is, and dry it for use. When wanted for balls, cut out each ball moderately true with a pen knife, and to round them more perfectly, and take off the rough edges, roll them very gently, with a circular motion, on a smooth table, and they will be fit for use. Cork balls may be cut in the same manner, but to make them smooth each one must be placed upon the point of a needle, and turned round two or three times in the flame of a candle, or should the blackness thereby occasioned be an objection they may be rubbed with sand paper.

Ex. 48.—*Electric Bells.*—The apparatus thus called is of various forms—that put into action by attraction is represented in Fig. 8. It consists of a rod, or wire, having a hook to hang it up by, and a small chain at each end, terminated by a bell. There are, also, at three other parts depending from it three silk threads—one terminated by a third bell, the other two by metal clappers. The third bell, it will be observed, has a chain appended to it which reaches the ground. When this is suspended from the conductor, the wire at top, and bells at the sides, become electrified—these latter, therefore, attract the clappers. They thus becoming charged recede till they touch the centre bell, and thus the motion of the clappers, from one to the other, produces the sound of ringing.

(Continued on page 314.)

PHOTOGENIC ACTINOMETER.

BY PROFESSOR DAUBENY.

Read before the British Association, August 26, 1839.

PROFESSOR DAUBENY exhibited the model of an apparatus, by means of which, in a more complete condition, he hoped to obtain a numerical estimate of the intensity of solar light at different periods of the day, and in different parts of the globe. The contrivance consisted of a sheet of photogenic paper, moderately sensible, rolled round a cylinder, which, by means of machinery, would uncoil at a given rate, so as to expose to the direct action of the solar rays, for the space of an hour, a strip of the whole length of the sheet, and of about an inch in diameter. Between the paper and the light was to be interposed a vessel, with plane surfaces of glass at top and bottom, and in breadth corresponding to that of the strip of paper presented. This vessel, being wedge-shaped, was fitted to contain a body of fluid of gradually-increasing thickness, so that, if calculated to absorb light, the proportion intercepted would augment in a gradually-increasing proportion from one extremity of the vessel to the other. Hence it was presumed that the discoloration arising from the action of light would proceed along the surface of the paper, to a greater or less extent, accordingly as the intensity of the sun's light was such as enabled it to penetrate through a greater or lesser thickness of the fluid employed. In order to register the results, nothing more was required than to measure, each evening, by means of a scale, how many degrees the discoloration had proceeded along the surface of the paper exposed to light, during each successive hour of the preceding day. To render the instrument self-registering, some contrivance for placing the paper always in a similar position with reference to the sun, must of course be superadded. The object of this contrivance differed from that aimed at by Sir J. Herschel in his Actinometer, being intended as a measure of the aggregate effect of the solar intensity at the period (be it long or short) during which the paper was submitted to its influence; whereas the Actinometer merely measures the intensity at the moment the observation is made. The interposition of an absorbing fluid has at least this advantage, that it enables the observer to estimate the relative intensity by marking the point at which the paper ceases to be discolored, of which the eye is able to judge more exactly than it could do of the relative darkness of shade, which might be produced on paper exposed unprotected to light of different degrees of brilliancy.

Mr. Jackson thought that a Heliostat, for throwing the reflected light of the sun upon the instrument, would be objectionable; and suggested, in preference, that the Heliostat should rather turn the instrument to the sun, which he considered could be effected with equal ease.—Dr. Daubeny assented.—Professor Forbes only first saw the instrument yesterday; he therefore could not speak with much confidence, but must own his first impressions were not very sanguine of its ultimate success. One objection was, the difficulty, if not impossibility, of procuring prepared or photogenic paper of exactly similar sensibility; and unless this were done, not even the observations of the same person, made at different times, could be compared, much less could any comparisons be made of the results of different observers. Another objection was the difficulty of observing where the discoloration extended to, as the shading off would be so gradual; so that different persons would come to different conclusions, according to the goodness or badness of their sight, upon the very same sheet of register paper. A third objection was, that the scale would be so complicated, that he much feared whether any scale be formed; for not only were the quantities of light which would be permitted to pass through a wedge-shaped mass of fluid, such as Dr. Daubeny proposed, diminished, in a geometrical proportion, as its thickness increased arithmetically, but it had now been clearly established by the researches of Melloni, Fresnel, and others, that the portion of light which had already passed through a portion of any medium, was in a state for passing with greater ease, or in a greater relative proportion, through equal portions of the remainder. Unquestionably self-registering instruments of all kinds were highly desirable, and an instrument fitted to perform what Dr. Daubeny proposed would be both interesting and valuable; and he thought the suggestions valuable, even supposing difficulties such as he alluded to should be found to exist.—Dr. Daubeny said, that, as to one of the objections, Sir John Herschel had informed him that any quantity of equally sensitive photogenic paper could be obtained; as to the scale, the indications were not intended to furnish absolute, but only relative results.

POLISHING PLASTER CASTS.

First Method.—Put into four pounds of clear water, one ounce of pure curd-soap, grated and dissolved in a well-glazed earthen vessel—then add one ounce of white bees'-wax, cut into thin slices; as soon as the whole is incorporated it is fit for use. Having well dried the figure before the fire, suspend it by a twine, and dip it once in the varnish; upon taking it out, the moisture will appear to have been absorbed in two minutes' time; stir the compost, and dip it a second time, and this generally suffices. Cover it carefully from the dust for a week; then, with soft muslin rag, or cotton wool, rub the figure gently, when a most brilliant gloss will be produced.

Second Method.—Take skimmed milk, and with a camel's hair pencil, lay over the model till it holds out, or will imbibe no more. Shake or blow off any that remains on the surface, and lay it in a place perfectly free from dust; when dry it will look like polished marble, and answers equally well with the former, except it is put outside the house in wet weather. If the milk is not carefully skimmed, it will not answer.

Third Method.—Fuse half an ounce of tin, with the same quantity of bismuth, in a crucible; when melted, add half an ounce of mercury, and when perfectly combined, take the mixture from the fire and cool it. This substance, mixed with the white of an egg, forms a most beautiful varnish for plaster of Paris casts.

METEOROLOGY.

THIS science, so sublime, useful, and interesting, has not received that share of notice which is justly due to it, but of late some advances we find are making in its progress, and strange it is, that so universal as its use is, no more respect has been shown it.

In passing to a few observations relative to this subject, I would recommend to every brother vo-

"Howard's Climate of London" published in 1833, as one of the best guides to a knowledge of meteorology, to assist in understanding our climate, and in keeping an account of our daily phenomena. I may at some future period offer a table of the diurnal state of instruments, but suffice it now, by way of introduction, to give a brief argument in favor of the science, accompanied by a few general observations on our atmosphere.

Meteorology is the only study which concerns all men alike, then why so few attend to it? Our notices are passed over with contempt; we are told that "they do not want to know what is past," and 'tis added, "tell us what is to come." Now if we were not to observe the past, we should deduce nothing whereby to judge of the future. Hence the need of strict observation of past and passing weather. Our bodies feel the changes, and health is effected by certain causes, and this with all men; while husbandry suffers for want of a knowledge of the portending of the skies. Many fits of illness too, from cold by getting wet, &c. for want of foresight, might be in some measure prevented were most people to notice the system of action in the air: hence then it would be well if all persons were more attentive to the passing characters of every day. To judge of the future we only need, from year to year, note down the past, so as to see how the clouds, daily appearances, and state of instruments were attended, as it may be so again on recurrence of the same circumstances, &c. It would be advisable at least, to the furtherance of our end, that one gentleman or more in every parish should keep a journal, and public records, wherein all notes be compared should be published, for knowing of the past, as regularly as the almanacs issue, for the assumed purpose of prediction.

Thus we see all men alike are, or ought to be, interested in this still-neglected study. The country is far more suitable for our researches than the metropolis itself; any where in open plains is indeed better than any large town, as houses thickly built hide the horizon and greater portion of sky from the observer.

Temperature is as interesting in its variations as the weight of the air. The hottest days on record in England were in July, 1721; July 12th to 11th, 1808; July 11th to 19th, 1825; and June 27th and 28th, 1826. The thermometer at all those periods being at 90° and above. On July 11th, 1808, it stood 99° at Ipswich, and 98½° at Redgrave in Suffolk. In 1825, on July 18th and 19th, it was nearly as high in some parts of England. The coldest times were December 25th, 1796; December 31st, 1799; February 9th, 1816; January 14th, 1820; and January 20th, 1838; at all which periods the thermometer was at or below zero. Hence our temperature has had a range of about 100°. The winter of 1814 was long and severe, but no day so cold as the above. Great and sudden transitions from cold to heat often happen at the end of April, or near that time. Of late years the most striking instances of this occurred in 1827, when on April 25th it froze, thermometer 29°, and on 30th of same month a temperature of 77° or more was experienced, and at Epping it was 81°. And in 1833, after a long period of wet and cold to May 2nd, when it became intensely hot and dry till June 11th. On May 4th the thermometer ascended to about 27° above the previous daily state, and it stood far above 80° for many days, and 17th at 85¼°.

Great changes both ways, or alternately, often mark our vernal months, and hence the ill effects on the body. The usual maximum and minimum appear to be 82° and 20° in our climate, and usually happen in January and July. The barometer was at the minimum ever noted on December 24th, 1821, and following morning, viz. 27·80, in some places less, and at its maximum known January 2nd, 1835, viz. 30·92.

The most prevailing winds are the SW. and the NE. The most awful thunder and lightning recorded were on August 9th, 1787, general all night over Europe. In London, June 14th, 1814. In Essex, Herts, &c. July 14th, 1824. In London, August 14th, 1836; May 11th, 1837; and May 8th; June 17th; July 7th; and August 7th, 1839. General in England July 30th, 1820; *April 20th, 1821, (Good Friday); August 25th, 1826; July 30th, 1827; June 25th, 1830, (Death of George IV); July 28th, 1834; and June 17th and July 7th, 1839; all these having been by night, or early in the morning.

In conclusion, let me add, that the heat on the 3rd of August, 1839, a day just passed, exceeded any for thirteen previous years in this part, thermometer 89° in the shade, 104° in water exposed to sun 3 feet from ground, and 114° in the sun, on a plane elevated 4 feet, and in open space away from buildings or walls. O. WHISTLECRAFT.

Thwaite, Suffolk, Aug. 23, 1839.

RAILWAYS.

(Resumed from page 173.)

Route.—The first enquiry presenting itself, in respect to a railroad between two points, relates to the choice of a route, where the nature of the territory permits of any such choice. In making this election, the comparative distances, the amount of intermediate transportation to be accommodated, the character of the soil as to affording a good foundation, the excavations and embankments necessary to be made in order to bring the road within a certain scale of inclination, and difficulty or facility of obtaining suitable materials for the construction of the road, are all to be taken into consideration. These investigations and comparisons cannot be too rigidly and minutely made; and it has been suggested by experienced engineers, that in some of the roads of this description constructed in the United States, great mistakes will be found to have been made in this respect, in consequence of too great precipitancy in fixing on a route.

Gradients or Inclination.—The scale of inclination to which the road is to be reduced, is necessarily taken into consideration in fixing upon the general route; but still a choice often presents itself in parts of such routes, between the expense of reducing the rate of inclination, by excavations and embankments, and the saving of expense by taking a more circuitous route. Another question also presents itself, namely, whether to reduce an acclivity, or to surmount it; and the manner of overcoming it is a subject of enquiry at the same time; for, the surface of the ground having been examined and the route determined on, a general scale of inclination, within which the ordinary power used for transportation is to be applied, the whole line is either to be brought within this scale, or if an inclination exceeding it is admitted it is to be overcome by the use of an extra power. In

such case, if the extraordinary expense of reducing the inclination is not so great that the interest upon this part of the original outlay would exceed the additional expense of the use of an extra power to overcome an inclined plane, it will be a decisive reason in favor of reducing the inclination. The amount of transportation to be accommodated will determine, in a great degree, the expense of the extra power requisite to overcome a given inclined plane. Another circumstance to be considered is, whether the extra power to be used is that of horses, or steam, or water; for the two former are comparatively more expensive for a small than for a large amount of transportation, owing to the cost of maintaining them; but the difference is not so great where a water power can be used. In some cases it may be better to make deflections in the road, than to reduce inclinations, or to use extra power. This will depend on the kind of transportation and the importance of celerity; for if the object is mainly the transportation of increased weight by the same power, without regard to the time, any deviation from a direct course is less objectionable. But upon lines of public travel, dispatch is of great importance.

In the recently constructed railroads in England the iron rails are in general supported by iron chairs or props, at a distance of about three feet from each other. Lately the ribs are made in lengths of fifteen feet, so that two-thirds of the sleepers or bearings are saved. Where the rails rest on a line of wood, the track must be comparatively imperfect, since the wood will yield to the weight of the load transported, and be slightly compressed as the wheels pass, thus offering a continual resistance. Where successive parts of track are formed by laying iron rails upon pine, oak, and stone, the difference of power necessary to move the same load on the different parts, will be evident in the different degrees of exertion made by the horse, where this power is used. Accordingly, if a soft species of wood is used to support the iron rail, it is of great advantage to interpose a line of oak or other hard wood. A rail continuously supported by a line of stone will not yield to the weight of the load; and where the rail is supported at successive points by chairs, it is always intended to be of such strength, that it will not be sensibly bent by the weight. Continued lines of granite or other durable stone, are now in use on a number of railroads in the United States of America, but cannot as yet be considered to be so thoroughly tested, though the results of the experiments are thus far very favorable. It was apprehended, at first, that the action of the wheel would draw or flatten the iron plate; but it has been found by experience, that this effect is not produced. The principal difficulty in the use of this kind of track, was in the fastening of the rail to the stone, the nails used for this purpose being liable to be loosened or cut off by the expansion and contraction of the iron rail. This defect has, however, been partially remedied by making oval holes in the rails for the fastenings, thus allowing a little longitudinal motion of the rail without injury to the fastening. Cast iron rails do not so easily bend, and the same weight of iron is also much cheaper. But they are more subject to be broken by sudden jars and blows, and a much greater weight must be used in order to obtain the requisite strength. In the tram railways, plate rails are used, with a perpendicular plate or rim at the outside edge of the rail, of two or three inches in eight to confine the wheels upon the railroad. In the mode of joining the rails, very important improvements have been made since the introduction of railways into more general use. The rails at first were only about three or three and a half feet in length, and fastened in the chairs by a pin running horizontally through each end of the rail, there being two holes in each chair for the admission of two pins for this purpose, one for the end of each rail, so that the fastenings were distinct. The consequence was, that if the chair did not stand upon a perfectly firm foundation, but upon one that yielded on one side, so that the chair leaned in the line of the road, one of the pins, and consequently the end of the rail fastened by it, would be depressed below the other, thus making a sudden break in the surface of the track, which would cause a jolt as the wheel passed over it, to the injury of both the road and the carriages, and the inconvenience of passengers. Mr. Wood says this defect was very frequent on railroads constructed upon this plan. It has been remedied by making the rails join by lapping with what is called the *half-lap*, and fastening the ends of both rails by one pin; so that, although a chair should lean in the line of the road, or be a little depressed below the others, still the two rails would present a smooth surface at their junction. The injury and inconvenience occasioned by the imperfections of the junctions of the rails were still further remedied by making the rails twelve or fifteen feet in length, supported at short distances as before, the form and dimensions of each part of the rail between any two supports being constructed as already described; by which means the number of junctions was reduced to one fourth or fifth of their former number. This was a very great step in the improvement of this species of road. An improvement, of great utility, has also been made in the mode of fastening the rails, by dispensing with the use of pins, which were liable to work loose. There are various forms of constructing the rails and chairs for this purpose, but they all agree in principle. One mode is by making a depression in the chair on one side of rail, into which a projection from its lower side precisely fits. If the rail is held close upon that side, it is thereby fixed to the chair, and can be moved only with the chair itself; and it so held by driving a key or wedge along the opposite side of the rails between the rail and the side of the chair projecting upon the side of the rail.

(Continued on page 197.)

Mr. TALBOT'S REMARKS ON THE DAGUERREOTYPE.

Read before the British Association, August 26, 1839.

M. Arago had stated to the Institute that the sciences of optics and chemistry united were insufficient in their present state to give any plausible explanation of this delicate and complicated process. If M. Arago, who had had the advantage of being for six months acquainted with the secret, and therefore of considering its nature in all points of view, was of this opinion, it seemed as if a call were made on all the cultivators of science to use their united endeavours, by the accumulation of new facts and arguments, to penetrate into the real

ture of these mysterious phenomena. For this son, Mr. Talbot said, he would offer to the section a small contribution, on his part, of new observations which might perhaps be of service towards the elucidation of this new branch of science. The first part of M. Daguerre's process consists in exposing a silver plate to the vapour of iodine, by which it becomes covered with a stratum of iodide of silver, which is sensitive to light. Mr. Talbot stated that this fact had been known to him for some time, and that it formed the basis of one of the most curious optical phenomena, which, as it did not appear to have been observed by M. Daguerre, he would describe to the meeting.

Place a small particle of iodine, the size of a pin's head, on a plate of silver, or on a piece of silver leaf spread on glass. Warm it very gently, and you will shortly see the particle become surrounded with a number of colored rings, whose tints resemble those of Newton's rings. Now, if these colored rings are brought into the light, a most singular phenomenon takes place; for the rings prove to be sensitive to the light, and their colors change, and after the lapse of a short time their original color is quite gone, and a new set of colors have arisen to occupy their places. These new colors are altogether unusual ones; they do not resemble anything in Newton's scale, but seem to conform to a system of their own. For instance, the two first colors are, *deep olive-green*, and *deep blue inclining to black*, which is quite unlike the commencement to Newton's scale. It will be understood that the outermost ring is here accounted the first, being due to the thinnest stratum of iodide of silver, farthest from the central particle. The number of rings visible is sometimes considerable. In the centre of all, the leaf becomes white and semi-transparent, like ivory. This white spot, when heated, turns yellow, again recovering its whiteness when cold; from which it is inferred to consist of iodide of silver in a perfect state. The colored rings seem to consist of iodide of silver in various stages of development. They have a further singular property, which, however, has not been sufficiently examined into. It is as follows: It is well known that gold leaf is transparent, transmitting a bluish green light; but no other metal has been described as possessing colored transparency. These rings of iodide of silver, however, possess it, being slightly transparent, and transmitting light of different colors. In order to see this, a small portion of the film should be isolated, which is best done by viewing it through a microscope. Mr. Talbot said, that he had considered the possibility of applying a silver plate thus combined with iodine to the purpose of photogenic drawing, but he had laid it aside as insufficient for that purpose, on account of its sensitiveness appearing to be much inferior to that of paper spread with chloride of silver, and therefore in an equal time it takes a much feebler impression. Now, however, M. Daguerre has disclosed the remarkable fact, that this feeble impression can be increased, brought out, and strengthened, at a subsequent time, by exposing the plate to the vapour of mercury. Another experiment was then related, in which a particle of iodine was caused to diffuse its vapour over a surface of mercury. In order to do this, a copper-plate was spread over with nitrate of mercury, and then rubbed very bright, and placed in a closed box along with a small cup containing iodine. The result was, a formation of Newton's rings of the greatest splendour, and of a larger size. But they did not appear to be in any degree sensitive to light.

The next point of M. Daguerre's process is, the exposure of the picture to the vapour of mercury—and this is by far the most enigmatical part of the whole process. For, he states that if you wish to view the picture in the usual manner, that is, vertically, you must hold the plate inclined to the vapour at an angle of 45°, and *vice versa.* Now this is something altogether extraordinary; for whoever heard of masses of vapour possessing determinate *sides*, so as to be capable of being presented to an object at a given angle? From the hasty considerations which he had been able as yet to give to it, his first impression was, that this fact bore a striking analogy to some others which he would mention. If a piece of silver leaf is exposed to the vapour of iodine, however uniform the tension of the vapour may be, yet it does not combine uniformly with the metal, but the combination *commences* at the edge of the leaf and spreads inwards, as is manifested by the formation of successive bands of color parallel to the edge. This is not peculiar to silver and iodine, but occurs when other metals are exposed to other vapours: not always with entire regularity, but it displays a tendency to combine in that way. A possible explanation is, that this is due to the powerful electrical effect which the sharp edges and points of bodies are known to possess; in fact, that electricity is either the cause or the attending consequence of the combination of vapour with a metallic body. Again, if a minute particle of iodine is laid on a steel plate, it liquefies, forming an iodide of iron, and a dew spreads around the central point. Now, if this dew is examined in a good microscope, its globules are seen not to be arranged casually, but in straight lines along the edges of the minute striæ or scratches which the microscope detects even on polished surfaces. This is another proof how vapour is attracted by sharp edges, for the sides of those striæ are such. Whether or not these facts had any relation to that observed by M. Daguerre, of the action of vapour at an angle of 45°, Mr. Talbot did not pretend to say, but thought them worthy of being mentioned to the Section. He observed, that it had been repeatedly stated in the *Comptes Rendus* of the French Institute, that M. Daguerre's substance was greatly superior in sensitiveness to the English photogenic paper. It now, however, appeared that it was to be understood in a peculiar sense, inasmuch as the first or direct effect of the French method was very little apparent, and was increased by a subsequent process. This circumstance rendered it difficult to institute a direct experimental comparison between them. If it could be accomplished, he doubted whether M. Daguerre's substance would be found more sensitive than his. The present degree of sensitiveness of the photogenic paper was stated to be as follows: it will take an impression from a common argand lamp in one minute, which is visible though weak. In ten minutes the impression is a pretty strong one. In full daylight the effect is nearly instantaneous. M. Arago had stated that M. Daguerre had obtained some indications of *color*. Mr. Talbot thereupon referred to his paper to the Royal Society, read last January, wherein he had stated the same thing, which M. Arago had omitted to mention. Since then, more considerable effects of color have been

noticed. In copying a colored print the colors are visible on the photograph, especially the *red*, which is very distinct. Some descriptions of photogenic paper show this more than others; but no means have yet been found of *fixing* those colors, and sunshine reduces them all to an uniformity of mere light and shade. Sir John Herschel has formed images of the solar spectrum, in which the change of color is seen from end to end of the spectrum, but most clearly at the red end. Mr. Talbot then mentioned a kind of photogenic pictures which afford a very capricious phenomenon. The objects are represented of a reddish color on a white ground, and the process leaving the pictures in such a state that they are neither *fixed*, nor yet the contrary, but in an intermediate state; that is to say, that when they are exposed to sunshine they neither remain unchanged, (as *fixed* pictures would do,) nor are they destroyed, (as *unfixed* pictures would be;) but this singularity occurs, that the white ground remains unaltered, while the color of the object delineated on its changes from reddish to black with great rapidity, after which no further change occurs. These facts (he thought) serve to illustrate the fertility of the subject, and show the great extent of yet unoccupied ground in this new branch of science.

An animated conversation ensued. The President asked several questions of Mr. Talbot, tending to remove difficulties; but the questions and replies succeeded each other with such rapidity, that we could scarcely catch their import.—Professor Forbes observed, that this communication involved subjects in which he felt deep interest, and asked Mr. Talbot whether he thought it would be possible to form extensive surfaces similar to that described, which turned yellow by heat, and whether its sensibility would exceed that of the ordinary chemical sympathetic inks.—Mr. Talbot did not know whether it would be possible to form extensive surfaces, but its sensibility to heat and cold was very great, and it had an advantage over any of the sympathetic inks with which he was acquainted.—Prof. Forbes then inquired, whether the rings and fringes described by Mr. Talbot as surrounding the particle of iodine, were those of Newton, or not rather those of Nobili,—Newton's reversed; and he also wished to know whether he had rightly apprehended the order in which Mr. Talbot had stated them to change color—was the olive-green developed on the inside, and the blue on the outside of the rings and fringes, or was it the reverse order?—Mr. Talbot replied, that the rings were, as Prof. Forbes said, those of Nobili, and not properly Newton's, he had used the phrase in the loose sense; the olive-green also was on the outside, and the blue on the inside. Mr. Talbot then gave some remarkable instances of the extreme sensibility of the paper he was able to produce, and said, that as the actual process of Daguerre had only been made public within the last few days, he had not been able to learn whether this sensibility could be surpassed. Some of the specimens exhibited in the Model Room had been completed in one minute, and some of them finished in five. It was very remarkable, that time seemed to injure some, and some kinds of the paper recovered their whiteness again after having been blackened by exposure to light.—Prof. Forbes, who had, within the last fortnight, witnessed the exhibition of Daguerre's method, gave some interesting details, particularly as to the rapidity and fidelity with which views upon the Seine had been copied; and concluded by saying, that he believed that artist prided himself nearly as much on the improvements he had made in the construction of the camera obscura, as on his skill in making the photogenic drawings, although these improvements had not as yet been made public.

SEALS.

Glass.—Nothing is so easy to make as these really useful and durable articles. First, procure a mould made of plaster of Paris, the exact counterpart of the seal wished for, and this may be made by pouring a mixture of plaster of Paris and water, of the consistence of cream, upon any engraved seal, previously slightly oiled: when set, remove the cast and let it thoroughly dry, when it will be fit for use: then place in the centre of a clear fire a bit of flint glass, holding it with a pair of iron pincers, being careful to hold it so as not to touch any of the black coals. When of a red, or still better of a white heat, take it from the fire, lay it upon the mould, and press upon the back of it so as to force it into all the depressions, and thus the seal is made. To finish it, it only requires to be ground round the edge into shape. If it be desired to imitate a sealing wax impression, it is necessary to oil it, pour common wax upon it, and take the plaster cast from this. The makers of glass, or as they are called, composition seals, usually melt the glass in a crucible, taking out a sufficient quantity with an iron rod. Their moulds also have usually a ridge, or frame, of plaster around them to ensure the proper shape at once, without after grinding.

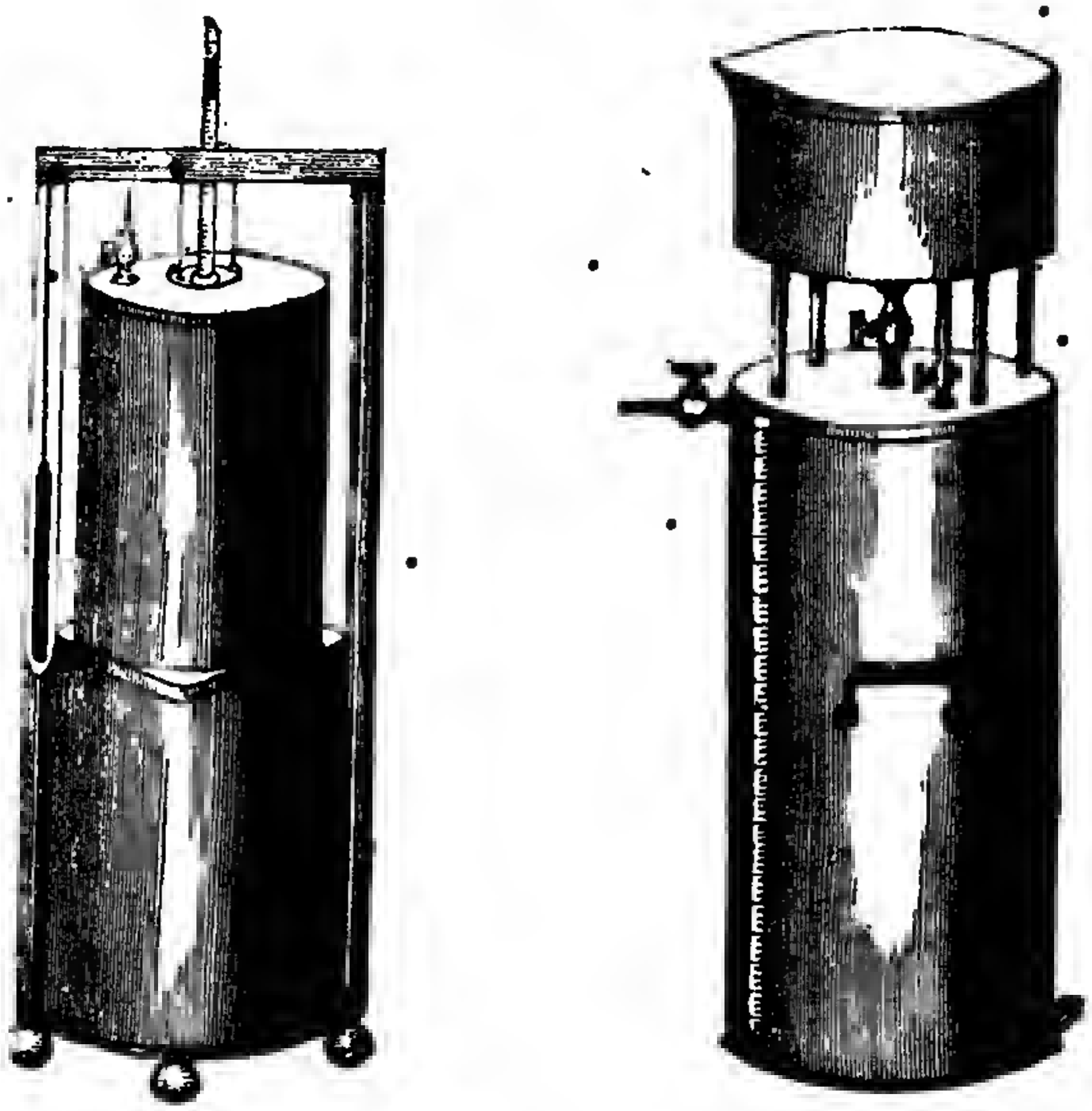
Bread.—Oil the impression which is to serve as a pattern very slightly with a camel-hair pencil dipped in sweet oil, or with a little piece of oiled wadding. Take a little new bread and knead it well in the hands, until it becomes a perfect paste, free from lumps and crumbs; color it with a little water color paint, but use no more than just enough to give the tint required. Then press a little of the bread *well into the impression.* Shape the top and remove it immediately; let it dry gradually. Sometimes gum water is mixed with the bread, but it generally causes the seals to crack in drying.

Gum.—These are made by merely pouring a little strong gum water over the impression, after being oiled slightly, and keep adding more as it dries. When about the consistence of Indian rubber it can be taken off with an open pen-knife, and a sort of handle added of bread, prepared as for bread seals.

MISCELLANIES.

To make Artificial Black Lead Pencils.—Melt together fine Cumberland black-lead in powder and shell lac. This compound is to be repeatedly powdered and re-melted until of uniform composition; it is then sawn into slips, and mounted as usual. Pencils thus made are uniform, and of great strength, and there is no waste of materials.

To get Oil out of Boards.—Mix together fuller's earth and soap lees, and rub it into the boards. Let it dry and then scour it off with some strong soft soap and sand, or use lees to scour it with. It should be put on hot, which may be easily done, by heating the lees.



THE GAS-HOLDER AND GASOMETER

In the manufacture of various gases, for the purposes of chemical experiment, it is evidently necessary to have some instrument, or apparatus, for storing up the gas as it is procured, which apparatus varies, not merely on account of the quantity required, but also as to the nature of the gas itself, whether it be capable of combining with water or not, and other circumstances not here necessary to allude to. The simplest form of a gas-holder is a common bladder, with a stop-cock fastened to the orifice of it. When used, it is merely to be attached to the bottle, retort, or other vessel, in which the gas is being liberated. This is a cheap, and, in some cases, a sufficiently perfect instrument, but only for such gases as may not be wanted very pure, as is the case in ordinary experiments with oxygen, hydrogen, and carbonic acid. Also a bladder is often a convenient temporary gasometer, as when a gas has been purified by other means, a bladder may then be filled—thus nitrous oxyde gas, or the laughing gas, may conveniently be administered from a bladder—though to purify it, it must previously have been kept some hours over the surface of water. Those gases, which are absorbable by water, should, for chemical purposes, be received in jars over mercury, but it is not every chemist who has, or can afford to have, a mercurial trough. A bladder then is his only resource—thus chlorine, sulphuretted hydrogen, muriatic acid gas, &c. &c., may be easily collected and kept for use, though the chemical operator will not expect the gases to be wholly pure, when made in such an off-hand manner, though he will scarcely fail in his experiments respecting any of them from this cause.

But bladders are perishable, limited in capacity, and possess no adaptation to separate those impurities which are taken up by water, with or without various necessary materials added to it. These inconveniences have given rise to the invention of gasometers and gas-holders. The most useful one of each kind is the paramount object of the present observations, and the wood-cuts which precede them.

Fig. 1 represents the *Gasometer*. It may be made of japanned iron or copper. It consists of an outer circular vessel, to the sides of which are fastened two tubes, running upright, and about double the height of the vessel below. Across the top of these tubes is fixed a similar one, which has a hole in the centre, and is furnished with two small pullies near this hole, one on each end of it; and also two similar pullies exactly at the corners. These are wholly hid from observation by the tube when the machine is finished, but the internal arrangement of these, on one side, may be seen in the cut. A little smaller than the vessel already alluded to is another, made so as to pass very easily up and down in it. To the centre of this second vessel on the top is fixed a square rod of wood, graduated to show the quantity of gas withinside the gasometer from time to time. This rod passes through the cross bar at top. Near where the graduated tube is fixed are two rings or staples having each a string to it, which passes over the two pullies of its own side, and supports a weight at the other end—thus it will be seen that the side tubes contain two weights, which should be such as exactly to counterbalance the vessel to which they are suspended. A stop cock may be fastened, as represented, to let out the gas, when wanted for use, into jars, bladders, or other apparatus. This cock also will admit the gas into the receiver from the apparatus where it is being liberated. To use the gasometer, first let the receiver, or inner vessel, fall to the bottom of the pail, or outer vessel, and fill the latter with water, then open the cock, and fasten it to the tube which conveys the gas from the retort. The gas rises, and gradually fills and lifts up the cylinder, and, when sufficiently filled, the cock by which it entered must be closed. The gas may afterwards be drawn off as wanted.

The *Gas-Holder*, which was the invention of Mr. Pepys, is represented in Fig. 2. It consists of a body, or reservoir, closed at top and bottom, which may hold from two to eight gallons. Above this, and supported by four legs, is a cistern, open at the top, and connected with the body by two cocks. The larger of which, (the centre one,) has a pipe running down to very near the bottom, so that when the gas-holder is but partly filled with gas, none can possibly escape by this cock. The other cock, which is between the cistern and body, merely connects the two vessels, and if left open the gas would rapidly escape through it. Another cock is attached near the top, on the side of the body, to draw off the gas when wanted for use, and near the bottom is a short thick tube, to which is accurately fitted a screw. To use the gas-holder, tighten the screw on the end of the short tube at bottom, then open all three cocks at top, and fill the whole with water, by pouring a requisite quantity into the cistern. Now close all three of the upper cocks, and open the screw at the bottom. The water within will not flow out, although this hole is open. Into this hole the beak of the retort is to be fixed, as the gas rises from it the water will pour out below. The quantity which may be contained in the gas-holder from time to time is indicated by a graduated glass tube, which runs on the outside from the top to the bottom of it. When the gas-holder is full, screw on again the end of the tube at bottom. When the gas is wanted for use it may either be drawn off by the cock on the side, or the small one at the top, being careful to open before either of them the larger cock in the middle, and keep the cistern filled with water, as this is wanted to occupy the receiver when the gas is drawn from it.

ON RAIN AND THE RAINBOW.

NAVIGATORS occasionally speak of rains which fall on their vessels while traversing the equinoctial regions, in terms which would lead us to suppose that it rains much more abundantly at sea than on land. But the truth still remains in the domain o. mere conjecture; so seldom has the trouble been taken to procure exact measurements. These measurements, however, are by no means difficult. Captain Tuckey, for example, made many during his unfortunate expedition to the river Zaire, or Congo.

Navigators would add greatly to the interest of these observations, if they would observe at the same time the temperature of the rain, and the height from which it falls.

In order to obtain the temperature of rain with some degree of accuracy, it is necessary that the mass of the water should be considerable, relatively to the size of the vessel which contains it. A metal udometer will not answer for this purpose. It would be infinitely preferable to take a large funnel of some light stuff, very close in its texture, and to receive the water which runs from the bottom in a glass, whose sides are thin, and which contains a small thermometer. The elevation of the clouds in which the rain is formed cannot be determined but during the time of a storm; then, the number of seconds which elapse between the appearance of the flash, and the arrival of the sound, multiplied by 1142—the velocity with which sound is propagated—gives the length of the hypothenuse of a right-angled triangle, whose vertical side is precisely the height required. This height may be calculated, if, by means of a reflecting instrument, we obtain the angle formed with the horizon by a line, which, passing from the eye of the observer, terminates in that quarter of the cloud where the lightning first showed itself.

Let us suppose, for an instant, that there falls on the vessel rain whose temperature is below that which the clouds should possess, according to their height, and the known rate of the decrease of atmospheric heat; every one will understand the consequences which such a result would produce in meteorology.

Let us suppose, on the other hand, that during a day of hail, (for it hails in the open sea,) the same system of observations had proved that hail-stones were formed in a region where the atmospheric temperature was higher than that at which water congeals,—science would thus be furnished with a valuable result, which every future theory of hail must necessarily account for.

There are some extraordinary phenomena, concerning which science possesses but few observations; and for the reason, that those who have had the opportunity of witnessing them avoid

describing them, from an apprehension that they might be regarded as undiscerning visionaries. In the number of these phenomena we may rank certain rains of the equinoctial regions.

Sometimes it rains between the tropics when the atmosphere is perfectly clear, and the sky of the most beautiful azure. The drops are not very numerous, but they are larger than the greatest rain-drops in our climates. The fact is certain; we have the evidence of M. von Humboldt that he has observed the occurrence in the interior of continents, and Captain Beechey states that he has witnessed it in the open sea. With regard to the circumstances on which such a singular precipitation of water depends we are entirely ignorant. In Europe we sometimes see during the day, in cold and perfectly clear weather, small crystals of ice falling slowly from the air, their size increasing with every particle of humidity they congeal in their passage. Does not this approximation put us in the way of obtaining the desired explanation? Have not the large rain-drops been at first, in the higher regions of the atmosphere, small particles of ice excessively cold; then have they not become, as they descended, large ice-flakes by means of accumulation; and when lower still, have they not melted into drops of water. It will be readily understood that the only object with which these conjectures are brought forward in this place is, to show in what point of view the phenomenon may be studied, and to stimulate our young travellers, in particular, to observe carefully if, during these singular rains, the region of the sky from which they fall presents any traces of halo. If such traces are perceived, however slight they may be, the existence of crystals of ice in the higher regions of the air would be demonstrated.

The explanation of the rainbow may be regarded as one of Descartes's most beautiful discoveries; but, still, even after the developments which Newton has furnished, it is yet incomplete. When we look attentively at this magnificent phenomenon, we perceive under the red of the interior arch several series of green and purple, forming narrow contiguous arches, well defined, and perfectly concentric to the principal arch. Of these *supplementary* arcs (for that is the name given to them,) the theory of Descartes and Newton takes no notice, and indeed it cannot even be applied to them.

The supplementary arcs appear to be an effect of luminous interference. These interferences cannot be produced but by drops of water of a certain smallness. It is necessary also, for otherwise the phenomenon would have no brilliancy, that, besides this condition of magnitude, the drops, or at least the greater part of them, should be almost mathematically equal in their dimensions. If, therefore, the rainbows of equinoctial regions are never attended with supplementary arcs, it would be a proof that the drops of water which there issue from the clouds are of larger size, and more unequal dimensions, than in our climates. In our ignorance of the causes of rain, this fact would by no means be void of interest.

When the sun is low, the upper portion of the rainbow is, on the contrary, very much elevated. It is towards this culminating region that the supplementary arcs show themselves in greatest splendour. Descending from this, their colors become rapidly fainter. In the lower regions, near the horizon, and even considerably above it, no traces of them are ever seen, at least in Europe.

It follows, therefore, that rain-drops, during their vertical descent, lose the property which they at first possess; that they have no longer the conditions necessary for efficient interference, and that they increase in size.

Is it not curious, it may be asked in passing, to find in an optical phenomenon, in a peculiarity of the rainbow, a proof that in Europe the quantity of rain must be so much the less the higher we place the vessel in which it is to be received? In the Observatory, at Paris, there are two vessels in which rain-water is collected; one of them is on the terrace, the other in the court, 92 English feet lower than the first. In the course of a year the reservoir in the court received eight-hundredths *more* water than that placed on the terrace.

The increase in the size of the drops, it can scarcely be doubted, is owing to a precipitation of humidity on their surface; this will be in proportion to the atmospheric strata through which they pass in their descent from the cold region of their origin; and which strata are warmer and warmer, as they approach the earth. It is then almost certain that, if supplementary rainbows are formed in equinoctial regions, as in Europe, they never reach the horizon; but a comparison of the angle of the height at which they cease to be seen with the angle of disappearance noticed in our climates, seems to offer a means of obtaining some meteorological results, which can be obtained by no other method at present known.—M. ARAGO.

PAPER CASTS OF SCULPTURE.

My servants made me casts in paper of the sculpture of these two rooms, that is, one of all the sculpture in the three large plates which I now publish. This method of obtaining fac-similes of sculpture in basso-relievo is very successful, and so easy, that I had no difficulty in teaching it to my Arabs. I found stiff, unsized, common white paper, to be best adapted for the purpose. It should be well damped; and, when applied to sculpture still retaining its color, not to injure the latter, care should be taken that the side of the paper placed on the figures be dry—that it be not the side which has been sponged. The paper, when applied to the sculpture, should be evenly patted with a napkin folded rather stiffly; and, if any part of the figures or hieroglyphics be in intaglio or elaborately worked, it is better to press the paper over that part with the finger. Five minutes is quite sufficient time to make a cast of this description; when taken off the wall, it should be laid on the ground or sand to dry. I possess many hundred casts, which my Arabs made for me at Thebes and in the Oasis. Indeed, I very rarely made any drawings of sculpture without having a cast of the same; and as the latter are now quite as fresh as on the day they were taken, the engraver having not only my drawing, but also these indubitable fac-similes, is enabled to make my plates exactly like, and quite equal to the original.—*Hoskins's Visit to the Oasis.*

ARGAND; BEALE; BUDE, OR GURNEY; AND OXY-HYDROGEN, DRUMMOND, OR KONIOPHOSTIC LIGHTS.

So much of the comfort of mankind is derived from artificial light, that he may truly be considered a benefactor to his species who makes any

improvement in its production, or application. So evident is this, that one would have supposed that mankind, at a very early period of civilization, would have made such discoveries as to have raised this department of science to a respectable, if not a prominent, situation among human arts. Upon examination we shall discover that nothing but the smoky and feeble light of the flambeaux, and common oil lamps, was known until a very recent period in the history of science. Dr. Black and Count Romford turned the attention of philosophers to the subject, by proving how much more economically the same materials might be employed. To show most clearly the progress made of late years, and the cause of each particular improvement, it will be necessary to consider, briefly, the nature of flame, and the effect of currents of atmospheric air, and various gases, upon burning materials.

Artificial light varies in intensity from two causes: first, the nature of the combustible; and, secondly, the more or less perfect character of the support of combustion, with which it must always when burning be in contact. Of the latter character are most of the different lights which, of late years, have chiefly been submitted to public regard.

The substances which have been most applied to, for the production of flame, are various animal or vegetable oils, and tallows—pitch, and other resinous matters—spirits of wine—naphtha—coals—tar, &c. These, when submitted to a certain degree of heat, are decomposed, and carburetted hydrogen gas formed—this, being inflammable, burns, and gives light, whenever it is in such circumstances as to be in contact with atmospheric air, or else oxygen, the former indeed only because it contains oxygen, as is proved easily by direct experiment.

Ex.—Hold in the very centre of a large solid flame a fine glass tube—if this be held slanting upwards, a gas will rise through the tube, and may be lighted at the other end, showing that the flame of a common candle is hollow, and only appears luminous at the extreme outside of the flame, or when it is in contact with the air.

See also the effect of blowing the fire with the common bellows, how soon the application of a fresh supply of air revives the flame, and how terrific is often the effect when a sudden gust of wind meets with a burning house, when from a smouldering heap it becomes a glowing conflagration. To prove that it is oxygen which occasions this, we have only to consider the constituents of the air—one-fifth of it is oxygen, a powerful supporter of combustion—the other four-fifths nitrogen, which direct experiment proves to us to be not only incapable in the smallest degree of supporting flame, but which instantly extinguishes the most vivid and brilliant light, if it has not oxygen within itself to support its continuance.

Ex.—Hold a short lighted taper within a glass jar filled with common air—when the air in the jar is consumed, the taper will be extinguished. Mark the length of time of the burning, then immerse the same taper, again lighted, into a jar of oxygen gas; it will now burn with a far more vivid light than before, and five times as long, for this jar contains five times as much oxygen as the other.

Arguing from the above, and similar experiments, and applying the principle they involve, the *Argand Lamp* was first devised. This has a hollow wick, as we see in the common table lamps, where the wick fits on to a cylinder, moved up and down in a socket. The flame, therefore, is circular, and is in contact with a current of air, which rushes against it under the edge of the glass outside, and also from the cup below, into the central hollow space. The effect of which is, that a far greater quantity of light is given out by the same materials. As a proof that it is the greater contact of the air which occasions this, we have only to put a cork in the central hole of the wick, or what is the same thing, suffer the lower cup to be entirely filled with the oil which may leak out, when the current of air being intercepted the flame will be red, smoky, and of little illuminating power.

Following up the same train of thought, Mr. Beale argued that increasing the strength of this stream of air, would proportionably increase the intensity of the combustion, in the same manner as in the blast furnace: and putting into practice the idea, with some of that ingenuity and genius which his valuable steam-engine discoveries have shown him so fully to possess, the *Beale Light* was produced. This consists of a wick, which is supplied as in the other instances with oil, &c., and a current of air is forced up the centre of it, by a pair of bellows placed beneath, and which must be worked with the foot, or some mechanical contrivance. Thus the Beale Light is attended with a great disadvantage when wanted for private use, but for manufactories, where a lathe band can pass to some part of the machinery, it is valuable, and that for two reasons,—as the light given out is intense, and the very coarsest materials may be employed to feed the flame. The thickest and worst oils, and the refuse of the tar works, will answer the purpose.

The *Bude*, or *Gurney Light*.—The names of which are derived from the inventor, and his place of residence, is an improvement upon the above—Mr. Gurney admitting into the centre of the wick a fine stream of pure oxygen gas, instead of the blast of common air, as in the last instance. As might have been expected the flame is very greatly increased in vividness, so much so indeed that the undefended eye can scarcely bear the brilliancy of the emission; and instead of a large wick being requisite, and, of course, a proportionate expenditure of oil, Mr. Gurny can diminish the size of the flame to almost any extent. A flame of only five-eighths of an inch in diameter was found to afford a light equal to that of thirty wax candles, and it would appear from long-continued and careful experiments, conducted by Professor Faraday, that, while the cost of these candles, for a certain time, is 1*s.* 8*d.*, that of the Bude Light would be 10½*d.* only. It appears that no danger is likely to arise from the employment of this method of general illumination, that it is extremely easy to manage, and from its being a comparatively small light is capable of being employed even for optical instruments, while the heat given out by the combustion is not equal, nor even nearly so, to the corresponding light from candles, or gas. It may be necessary to remark, that spirits of turpentine is the combustible.

The *Drummond, Lime, Oxy-hydrogenic*, or *Koniophostic Light*, is totally different in mode of action. Here a stream of hydrogen unites with another of oxygen; fire is set to these united

streams—intense inflammation ensues—and this is thrown upon a small piece of lime, which becomes immediately of such a *white heat*, as to throw vivid beams all around. These, collected in a focus by means of mirrors, are reflected to an immense distance. Thus, under the name of the Drummond Light, it is used in light-houses. It is called the Lima Light by chemists. The Oxy-hydrogen, when employed, as it often is in the most powerful microscopic instruments, and is identical with that lately known at the Surrey Zoological Gardens as the Koniophostic Light.

Upon consideration of the various lights which have been alluded to, a circumstance will immediately strike our attention, and it will apply with equal force to the light of burning naphtha, and to the vivid emission of light arising from the charcoal points when a stream of galvanism passes through them, that they are *mono-chromatic*—that is, that all objects appear imperfect as to their colors. Thus, by the naphtha light for example, it would be impossible to match silks and other fabrics; and every one will have remarked the peculiar *moonlight* effect of the Bude Light at the Horse Guards, and the Koniophostic in Surrey. It is because the rays of light, although so vivid, have not the prismatic colors united in the same manner as in the solar spectrum. Thus an insuperable objection must at all times exist to the application of any of these lights for private use, though for the purposes of general illumination they may no doubt be made not merely available, but valuable.

TEA.

Tea is well known as the leaf of a hardy evergreen shrub, from three to six feet high, a little resembling the broad-leaved myrtle; it is polyandrous, and of the natural order *Columniferæ*; its blossoms white, with yellow style and anthers, much like the common dog-rose; the branches are numerous and full of leaves, and the leaves are long, serrated, rather pointed, fleshy and smooth, like those of some species of *camellia.* It will grow in our green-houses; and in warmer and more steady climates has been cultivated in the open air, especially in South America and in Australia; but for all purposes of commerce the growth of good tea is confined to certain provinces of China. There are several denominations of tea, but, without entering minutely into these, we may consider them under the general heads of *black* and *green.* According to some, these are two distinct species; but to others, mere varieties of one species, like those of the vine, climate, soil, aspect, time of gathering, and method of drying and managing the crop, being the cause of the difference. In fact, chemically speaking, black and green tea closely approximate; the black containing, perhaps, more extractive and less tan than the green; fine green is also distinguished by its refreshing and agreeable odour or perfume, evolved when acted on by hot water.

The proximate principles which the chemist finds in tea are, tannin, extract, resin, essential oil or aroma, and lignin or woody fibre: but the *extract* includes a peculiar bitter principle, probably belonging to that extraordinary class of vegetable products which have been termed *alkaloids*, and of which *morphia* from opium, and *quinia* from yellow Peruvian bark, furnish such interesting Such a substance has not, perhaps, been hitherto satisfactorily ascertained to be the stimulating and exhilarating principle of tea, though many circumstances tend to show its presence, and among them, the white precipitate, which a strong infusion of tea yields, with tincture of galls, or gallic acid. The substance described by Oudry under the name of *thein* is probably this principle.

It is not improbable, that much of the difference between black and green tea may arise from the greater or less heat to which the leaves have been exposed during the *manufacture* (as it is called) of the tea, as carried on by the Chinese; for the leaves are dried in rooms heated by charcoal fires: and in the process of *making*, that is, of rolling and twisting them up, they are submitted to a high temperature in shallow iron pans. Much, therefore, of the flavor and quality, or, in other words, of the composition of tea, must necessarily depend upon the heat applied, and upon the number of dryings; but the real extent and nature of such changes can only be learned from a careful analysis of the leaves before and after manufacture; that is, in their fresh, and in their prepared state: for the flavor and characters of tha green leaf are very distinct from those of the dried and prepared tea.

It may not be irrevalent to add here a few remarks on the varieties of tea with which we are most familiar. Of black teas, *Bohea*, or more properly *Voyee*, is the name of a *district; Congou* means *care in making; Souchong* is *little and good;* and *Peko* signifies *white leaf.*

With us *bohea* is the name of the commonest *black tea;* it is distinguished in the trade as Canton bohea, or *worst;* and Fokien bohea, or *best. Congou*, of which there are several kinds, occupies a place between bohea on the one side, and *souchong* on the other; but although this latter term is commonly applied, real souchong is a very scarce article, and the tea usually sold under that name is a very fine kind of congou. The kind of tea constituting the worst souchong and the best congou, is termed *campoi.*

Souchong has a fine and delicate flavor, and generally has pale leaves mixed with it: when without pale leaves, and with a certain mixture of white shoots, or of flowers (of the *olea fragrans)*, it forms *flowery peko. Ancoi* (from the name of a province), is also a grade of this tea. *Caper* is fine congou or souchong, rolled up into small globular forms; and *orange peko* is a very choice, highly-flavored tea, sometimes perfumed, and distinguished by its small and wiry leaf.

Mr. Reeves (*Evidence before a Committee of the House of Commons)* has given a very intelligible statement of the origin of these varieties. About the month of May, when the pickings begin, the tea-tree is in full leaf, and ready to throw out young shoots. The first white shoot, on the bud coming out, is covered with hairy filaments, and forms fine *flowery peko.* After a few days further growth, the hair falls off, the leaf expands, and it becomes *black-leaf peko.* The fleshy and fine leaves of the young shoots form *souchong:* the next best leaves make *campoi;* the next *congou;* and tha refuse leaves, *bohea.* These are the distinctive terms under which the teas are purchased of the farmers by the manufacturer, by whom they are afterwards variously mixed.

The varieties of *green tea* are, *twankay*, and

several kinds of *hyson;* the former is a coarse article. *Hyson* includes the finer kinds of green tea. The term *hyson-skin* is applied to the least perfectly rolled, and, therefore, lightest leaves. The finest hyson has a bright leaf, fresh flavor, and is well made or *twisted*. *Imperial* and *gunpowder* are more rolled and globular, the latter being finest and smallest. There is also *twankay-imperial* and *twankay-gunpowder*. The *siftings*, that is, the smaller leaves, are called *young twankay* and *young hyson*.

There is scarcely any article the delicacy of the flavor of which is so easily impaired as tea; hence the necessity of great caution in packing and warehousing it. Even the paper in which it is wrapped must be scrupulously looked to.

In our market, tea is judged of, in the first place, by its general appearance and character, and the color and state of the leaves, as being well or ill made; and, secondly, by its touch and weight. All the best teas are heavy, and therefore the least bulky for equal weights. The smell of tea is also an important guide, and infusions are made of each sample, by the flavor, color, and characters of which, the broker completes his judgment of this important article.

The adulteration of tea has sometimes been carried on to an enormous extent, and the details of the excise prosecutions, in reference to this nefarious traffic, have disclosed some curious information. Sloe, ash, and elder leaves, are the usual sources resorted to; and to a common and careless, or hasty observer, the imitations are not bad, especially when the leaves have been diligently rolled and twisted, and skilfully dyed by logwood, or a salt of iron. In regard to *green tea*, however, the matter is more serious, the color being given by a mixture of Dutch pink and verdigris, or carbonate of copper. These frauds are detected by infusing the leaves in warm water, so as to unroll them, when their forms may be examined, and compared with those of genuine tea; by the color, taste, and other qualities of the infusion; and by the blue color which they communicate to liquid ammonia, in those cases where the bloom is given by copper.

RIPPLE MARKS. MACKEREL SKY.

The small waves raised on the surface of the water by the passage of a slight breeze are called ripple; and a series of marks, very similar in appearance, which are sometimes seen at low water, on the flat part of a sea-beach formed of fine sand, are called ripple marks. Such marks occur in various strata, and are regarded as evidence of their having been formed beneath the sea. Similar appearance occur when a strong wind drives over the face of a sandy plain.

It appears that two fluids of different specific gravity, the lighter passing over the surface of the former, always concur in the formation of ripple. It seems also, that the lines of ripple mark are at right angles to the direction of the current which forms them.

If a fluid like air pass over the surface of perfectly quiescent water, in a plane absolutely parallel, it will have no effect; but if it impinge on the surface of that water with the slightest inclination, it will raise a small wave, which will be propagated by undulations to great distances. If the direction of the wind is very nearly parallel to the surface of the water, this first wave, being raised above the general surface, will protect that part of the water immediately beyond it from the full effect of the wind, which will therefore again impinge upon the water at a little distance; and, this concurring with the undulation, will tend to produce another small wave, and thus again, new waves will be produced. But the under surface of the air itself will also assume the form of waves; and so, on the slightest deviation at any one point from absolute parallelism in the two fluids, their whole surfaces will become covered with ripples.

If one of the fluids be water, and the lower fluid be fine sand, partially supported in water, these marks do not disappear when the cause ceases to act, as they do when formed by air on the surface of water. These are the marks we observe when the tide has receded from a flat sandy shore.

If, after the formation of ripple marks at the bottom of a shallow sea, some adjacent river, or some current, deposit upon them the mud which it holds in suspension, then the former marks will be preserved, and new ripple marks may appear above them. Such is the origin of those marks we observe in various sand-stones, from the most recent down to those of the coal measures.

Dr. Fitton informs me, that he found the sand hills on the south of Etaples (in France), consisting of ripple marks on a large scale. They are crescent-shaped hillocks, many of which are more than a hundred feet high. The height is greatest in the middle of the crescents, declining towards the points; and the slope on the inner side of the crescent, which is remote from the prevailing direction of the winds, is much more rapid than that on which it strikes.

Mr. Lyell has observed and described this mode of formation of ripple on the dunes of sand near Calais; remarking that in that case there is an actual lateral transfer—the grains of sand being carried by the wind up the less inclined slope of the ripple, and falling over the steep scarp. I have observed the same fact at Swansea.

A similar explanation seems to present itself as the origin of that form of clouds familiarly known as a "mackerel sky"—a wave-like appearance, which probably arises from the passage of a current of air above or below a thin stratum of clouds. The air being of nearly the same specific gravity as that of the cloud it acts upon, would produce ripples of larger size than would otherwise occur.

The surface of the sun presents to very good telescopes a certain mottled appearance, which is not exactly ripple, and which it is difficult to convey by description. It may, however, be suggested, that wherever such appearances occur, whether in planetary or in stellar bodies, or in the minuter precincts of the dye-house and the engine boiler, they indicate the fitness of an enquiry whether there are not two currents of fluid or semi-fluid matter, one moving with a different velocity over the other, the direction of the motion being at right angles to the lines of waves.—BABBAGE.

CASTING MEDALLIONS, FIGURES, &c., IN PLASTER AND SULPHUR.

The art of casting in sulphur and plaster of Paris, may, by some persons, be considered as of too trivial a nature to be made the subject of distinct and lengthened explanation. This opinion only can arise from being ignorant of the numerous and

very important applications of the art to the elucidation of many branches of science and history, as well as its being indispensable in all the arts in which casting of any description is necessary. We have ourselves made of one or other of these materials, not merely a very large collection of the finest engraved gems, and cameos of antiquity, but thousands of the rarest coins, medallions, and monkish seals; and casts of an infinite number of fossils, and other objects of natural history. These are not nearly all the varieties of objects usually made of plaster or sulphur, as the former material is especially adapted to form casts of architectural remains—models of the most elaborate edifices—busts—statuary—and moulds for various uses.

Casting in plaster and sulphur are converse operations; moulds in sulphur are used to cast in plaster, and moulds of the latter material for the casting of sulphur—therefore, in describing the one art, it is necessary at first to believe that the reader is acquainted with the other process.

Casting in Sulphur.—Suppose we have a number of the white plaster medallions, or casts of gems, such as are sold by the Italians, and desire to make moulds of them, from which other casts may be made afterwards, we must proceed as follows:—Prepare a few slips of stiff paper, such as writing paper, each about an inch broad, and long enough to go once or twice round the medallion. Soak the *back* of the medallion in a plate containing a little water, not enough, however, to come over the face of it, and here let it rest until in half-a-minute, or so, you will perceive that the water will be absorbed, so as to just show itself on the face of the medallion, making it more shining. When this is the case, take it out of the water directly, fold the slip of paper round it, and hold it between the thumb and finger of the left hand. While this is doing let there be melting on a slow fire some roll brimstone, in a pipkin, or patty pan, with a handle. As soon as ever a small quantity of the brimstone is melted, pour it carefully upon the face of the medallion, which you may turn about a little that the brimstone may flow over the whole face equally. Place it now upon the table, and pour more brimstone in, until you consider it of sufficient thickness to be strong, and this will be about a quarter of an inch. When crystallized, which will be in a minute or two, the paper may be untwisted, and the medallion and its mould separated from each other. If the operation has been well conducted, the medallion will be uninjured, and the mould will be seen to possess all the sharpness of the original, and casts made from it will be exact counterparts of it. If a second mould be wanted, dip in water the back of the medallion as before, but more slightly, and proceed to cast again in the same manner.

The above process is extremely easy, and yet it is possible that difficulties and imperfections will attend the first attempt at casting in sulphur. The following hints, however, may assist in removing some of these, and we introduce them the more readily, because we have always held that the most valuable instruction is that which teaches the student of any art wherein he is wrong, if unsuccessful in his operations, and how to remedy his mistakes upon future occasions; and because this practical knowledge is usually withheld, the processes described in Encyclopedias, &c., are mostly for this reason unsatisfactory—we had almost said useless.

Supposing then that the mould is not *sharp*—that it does not show in full perfection the delicate lines and angles, it is because the medallion has been too wet; in this case a second cast may often be taken without a fresh dipping in water.

If the cast and mould cannot be separated easily, or, when separated, some parts of the medallion break off, it shows that it has not been made wet enough. If this adhesion cannot be remedied, the whole is spoiled; they may, however, be often separated by a little contrivance. While adhering together place them plaster downwards upon the warm hob of a stove, or else hold the plaster part in warm water for a few seconds, in consequence of which a film of water will insinuate itself between the two surfaces, and tend to separate them.

In melting the sulphur much care is requisite, lest it should fire. If melting in a pipkin it may best be put out by covering it over with a saucer, or similar article; throwing water upon it would most likely scatter the burning mineral, and burst the vessel which contains it, or if not, it would be rendered totally unfit for casting. It must not be put to melt upon a fierce fire, for sulphur becomes, when too much heated, quite thick, and even brown—when melted at a more moderate heat, its color will soon change from its natural bright yellow to one more or less of fawn color and brown. This alteration of color is of no consequence in making moulds, nor yet, with one exception, in casting other objects in sulphur, but the thickness it acquires renders it unfit for the purpose wanted, until being set aside on the hob to cool for a few minutes, it will return again to almost the liquidity of water, when it is best adapted for the purpose. It is usual, when a number of moulds or medals are to be made at the same time, to melt gently a quantity of brimstone, and continue to use it until it congeals, for the colder it is, provided it will flow at all, the more perfect the moulds will be. Many persons will not take the trouble to hold each particular subject in the hand, but content themselves by soaking them adequately, wrapping them round with the strip of paper, fastening this with a wafer, putting it thus on a table, and pouring sulphur at once upon it—and thus some hundreds may be made in an hour.

Suppose it be requisite at any time to take a mould of a large square medallion, it must be surrounded not merely with paper, but four pieces of wood, that the brimstone may not escape; also, it is not advisable to hold it in the hand, because of the danger of being scalded. If a sulphur mould be wanted of a metallic, or other surface, not porous, it must be oiled previous to pouring the melted sulphur upon it, which will prevent the surfaces adhering together.

To cast sulphur upon sulphur is extremely difficult, and it may be said that to obtain a reverse of a sulphur mould, which has been made some time, is next to impossible, our only resource being to oil or grease well the original, pouring the fresh sulphur upon it, when so cold as to be near the point of congelation, and even with these precautions they often adhere together too strongly to be separated afterwards. But when a sulphur mould has been fresh made, and before the sulphur has arrived at the permanent color which it will assume, the same method of oiling, &c., being pursued, success will much more frequently attend the operation. The following method may be safely applied to at all times, not merely to reverse sulphur casts, but those in plaster also:—Procure some pipe clay, as clear as possible from sand, and

knead it up with the hand until, by putting a small ball of it upon the table, and pressing a halfpenny upon it, a good clear impression will be laft in the clay after the halfpenny is removed. It being in this state, press in the same manner the sulphur cast, and the reverse of it will be seen upon the clay. Pouring melted sulphur upon this, you would, of course, have a mould like that used to produce it; but if, instead of sulphur, plaster of Paris ba poured into it, it will make a plaster of Paris medallion exactly the contrary to that used before; and, casting from this, as in the first instance, it will be evident that a reveres sulphur mould will also be produced.

It will be no less avident that tha clay may ba used to reverse plaster medalliona also, for it is only to press upon the clay the chosen cast in plaster, it will make a mould of clay, and sulphur being poured upon it, that which was at first the one material will be now equally perfect in the other.

(Continued on page 213.)

MISCELLANIES.

Artificial Ivory.—Certain parties in this town have just obtained a patent for the making a substance so nearly resembling ivory, and so applicable to all the purposes of that valuable material, that it is almost impossible to detect the difference. We have not ourselves seen the mock ivory, but we are told that in one instance a working cutler had a quantity of scales given out to him consisting partly of the fictitious compound, and partly of ivory, and that he used them in hafting his knives, and returned his work without discovering the difference. We understand that an imitation tortoiseshell is prepared and in use, which, for some purposes, is littla inferior to some varieties of the real article. It may be expected, therefore, that the quadruped and the reptile for which our artista have hitherto been indebted for the precious substances above named, will henceforth be "left alone in their glory."—*Sheffield Paper.*

New Mode of Marking Linen.—A German chemist, Mr. Hoenle, has invented a new plan for marking linen without ink. This is effected by simply covering the linen with a fine coating of *pounded white sugar.* The stamp of iron very much heated, is impressed on this material. Two seconds suffice for the operation. The linen remains slightly scorched, but the mark is indelible. Query?

Engravings on Marble.—A discovery, of some importance to the statuary, has recently been made by Mr. C. Page, of Pimlico, by means of which, engraving on marble is greatly improved. While cutting letters in marble, in the ordinary method, the edges chip off, and the defects are covered by painting them over; but Mr. Page obviates this difficulty, by covering the surface of the polished marble with a coat of cement *before the chisel is used.* The cemant effectually prevents the marble from chipping; and when the coating is removed, the letters remain as perfect as if cut in copper.

Gem Cutters Paste is prepared thus:—An ounce of virgin wax, melted slowly in a copper vessel, and a drachm of sugar candy pounded well, half an ounce of burnt soot, and two or three drops of turpentine. The wax is warmed if a cast is to be taken, and the stone, having been a little moistened, is pressed on it.

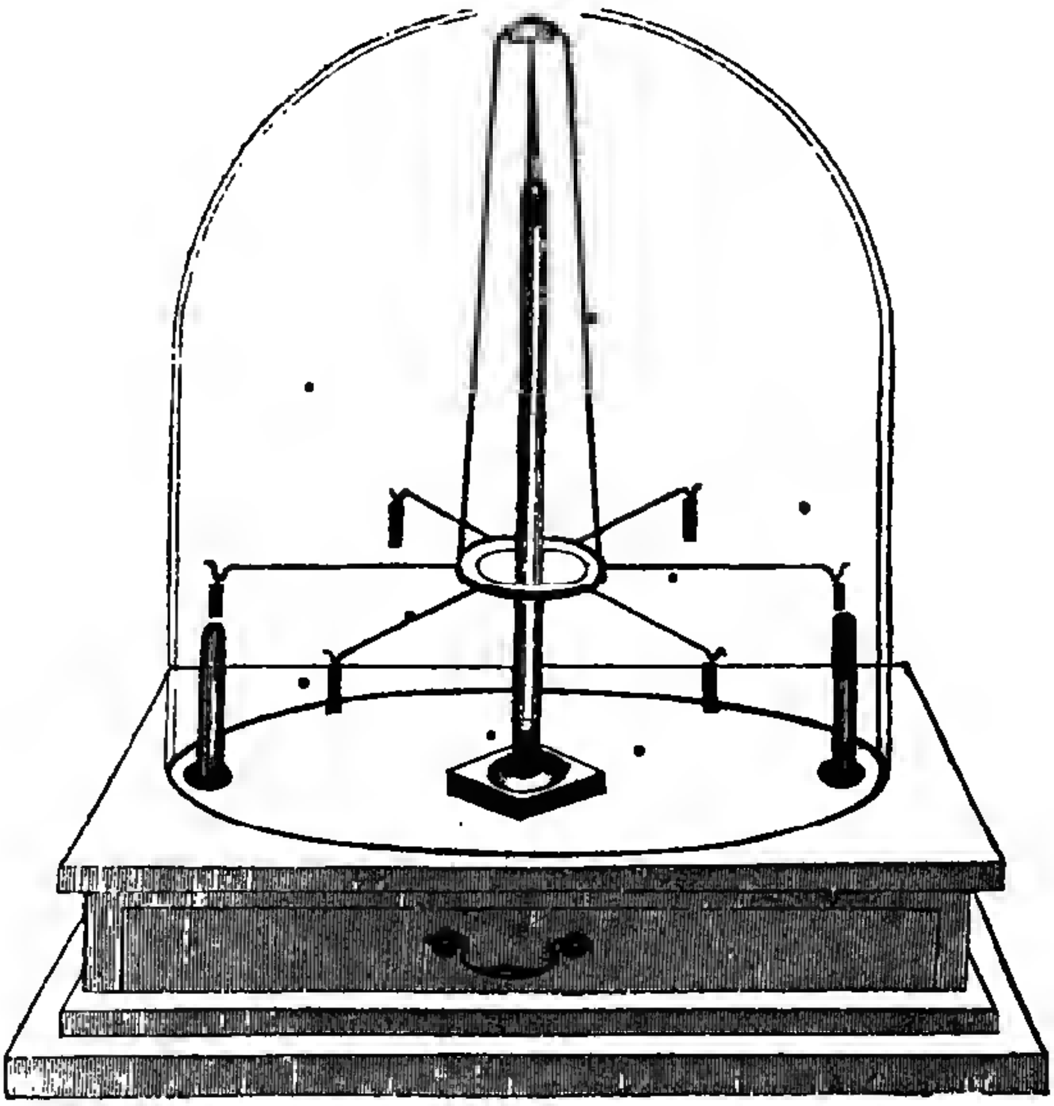
Soap Suds a Specific for Nourishing Flowers.—A fair correspondent writes to us from Newton Stewart in the following terms:—"Recently I happened to gather a beautiful pansey, and when tired of admiring it, tossed the toy aside, which, partly by accident, fell into a tub full of soap suds. The said pansey had neither joint nor root, and you may judge of my surprise when, at the end of a day or two, I found it growing. From this time forward I watched it narrowly, and now find it, after a lapse of a fortnight, a goodly plant with several buds on it. Thinking water might produce the sama affect, I placed a newly-cropped pansey in an element which, pure in itself, is the medium of purity in everything else; but it withered and died on so spare a diet. By the way of confirming the first experiment, I have since placed a slip of a rose tree and a pink, in suds, and both are flourishing in great vigour in my dressing room. Should this accidental discovery prove useful to florists, it will afford sincere pleasure to your correspondent."—*Dumfries Paper.*

Grand Undertaking.—An Italian engineer of the name of Volta, has had the boldness to propose a tunnel through the enormous Alps of "The Splugen,"—one of the boldest rocky barriers in the Alpine range. The present difficult, though important passage, is to give way to a railway, on a gigantic scale indeed;—of which the Laka o. Zurich will form one terminus; the other to be met by the railway from Como to Milan. The granite rock is expected to yield easily to the operation of the engineer. The *materiel* will be useful in the construction of the proposed work. This brilliant and daring project appears not unlikely to be carried into effect, two Cantons having joined in the enterprise.

To Clean Paper Hangings.—Cut into eight half quarters a stale quartern loaf: with one of these pieces, after having blown off all the dust from the paper to be cleaned by means of a good pair of bellows, begin at the top of the room, holding the crust in the hand, and wiping lightly downward with the crumb, about half a yard at each stroke, till the upper part of the hangings is completely cleaned all round; then go again round with the like sweeping stroke downward, always commencing each successive course a little higher than the upper stroke had extended till the bottom be finished. This operation, if carefully performed, will frequently make very old paper look almost equal to new. Great caution must be used not by any means to rub tha paper hard, nor to attempt cleaning it the cross or horizontal way. The dirty part of the bread too must be each time cut away, and the pieces renewed as soon as at all necessary.

To Preserve Young Shoots from Slugs and Earwigs.—Earwigs and slugs are fond of the points of the young shoots of carnations and pinks, and are very troublesome in places where they abound; to prevent them they are sometimes insulated in water, being set in cisterns or pans. If a pencil dipped in oil, was drawn round the bottom of the pots once in two days, neither of these insects, nor ants, would attempt them. Few insects can endure oil, and the smallest quantity of it stops their progress.

No. 1.



PERPETUAL MOTION—DE LUC'S AND MELLONI'S.

No. 2.

PERPETUAL MOTION.

If by perpetual motion be understood a power which moves, and which will move to the end of time, without regard to the wear and perishable nature of materials, it is in vain to expect such can be made by human means and human intelligence, however much we may hope for future discoveries in science to aid us. In the works of God alone we must look for such perfection, and continuity of motion. The planets roll—the ocean tosses—and eternal changes occur in the material world. The Great Architect of all made not only the machines themselves, but the laws which govern and move them. We can only abide by those laws already in action, and must therefore construct our machines according to these previously-arranged impulses; and unfortunately for the visionary schemer of the perpetual motion these laws are too stubborn for him to modify, much less destroy. Even supposing he should content himself with an apparatus, which would move only while its materials held together—the resistance of the air—the friction of the various parts—their vis inertiæ, and the general laws of gravitation—are impediments never to be overcome; and although all have failed, yet much ingenuity has been exerted, and talent called into exercise, by the many attempts which have been made to surmount them.

Mechanics, particularly the known properties of the lever, have given rise to innumerable schemes. One was called *The Valley Windmill.* This consisted of a wheel with five arms, each arm made of two pieces connected end to end by a joint. When made to turn round, the jointed ends on one side fell back, or rather hung down from the end of the fixed part of the arm, rising to the greatest elevation it hung close to the fixed arm; passing beyond this it fell back towards the centre, and thus by its position making a shorter lever, it bore with less weight—but when it had gone a little further, altering its centre of gravity, it fell down suddenly—when the moveable and fixed arm became one long lever, much heavier than in any other position, and this extra weight was to turn the whole. The machine had but one fault—*it wouldn't go. The Wheel of Balls*, described by the Marquis of Worcester, was another scheme. This was a very shallow drum, divided into a number of compartments, into each of which a leaden ball was placed, and as the wheel turns round each ball rolls alternately to and from the centre of the wheel, and it would seem from the principle of the lever, that as the weights are always further from the centre on one side than on the other a continuous rotatory motion must be produced; but it was found that though the balls were thus placed, yet a very few of them were away from the centre, while there were many near to it—thus those on one side counteracted those on the other, and, as in the other instance, the machine *wouldn't go.*

Hydraulics, pneumatics, and chemistry, all lent their aid, but in vain. Water-wheels were to throw up water enough to turn themselves. Pumps were to move by self-created power. Water-balances were alternately to rise and fall by each other's weight. Blasts of air were to work bellows, and the bellows were to produce the blasts of air. Hydrostatic paradoxes became numerous. Barker's mills were in requisition. Fire was to produce steam, and steam was to be decomposed by fire—and hundreds of other wise contrivances were set on foot to produce perpetual motion—we need not say with what result.

Then electricity was tried, and with infinitely more success than any other power; and this because we have a comparatively manageable agent, and one which is not affected by the powerful influence of gravitation.

We shall describe two of these perpetual motion machines:—De Luc's Dry Pile, or Electrical Column, and Melloni's Rotatory Pile. The former may be made thus:—Procure two glass tubes, about nine inches long each, and half-an-inch internal diameter. Bore two holes, about three inches apart, in a board, just large enough for the glass tubes to pass through. Cut the board to a convenient size for a stand, and fasten the tubes in the holes prepared for them, so that they shall stand upright, and parallel to each other. Then close the tubes at the bottom by a piece of metal which runs from one to the other. Next cover some sheets of paper with copper leaf on one side, and silver leaf on the other, and when dry cut them up with a round punch into pieces like wafers—of a size to go into the glass tubes. Then load both tubes with these, being very careful to put the copper side downwards in one pile, and silver side downwards in the other. When you have thus put in about *twenty thousand* altogether it will be sufficient, and the tubes may be closed by a brass cap at the top of each, which must touch the metal discs inside; if the tubes are not full they may be cut shorter, or tin foil put in to fill up. The two piles thus constructed will show positive electricity at one of the upper extremities and negative at the other, and this for a series of months—it is said years; and anything so placed as to vibrate between the two caps will keep in motion as long as the tubes retain their power.

The machine of Melloni is eactly similar in principle, though it varies somewhat in form, (see cut No. 1,) where the machine is shown about one-half its natural size. At the lower part is a drawer, (seen better in cut No. 2.) This is divided into a convenient number of partitions, about half-an-inch from each other. The outer partition, on each side is connected by means of wires to two brass poles, one negative, and the other positive, seen standing upright, one on each side of the stand of cut No. 1. The paper used is covered on one side with copper leaf, or *Dutch metal*, and on the other side with the black oxyde of manganese and honey—it is cut up into small square pieces, and arranged along the various partitions of the drawer, being very careful that the copper side of them always turns the same way—that is, if the feather of the arrows in the cut represented the manganese, the point of them would indicate the copper—a piece of wire, or tin-foil, at the end will always connect one row to the next. About 20,000 discs are wanted, and when they are properly placed, and the ends connected with the poles, the motive power is complete, and will show negative and positive attraction. The rest of the cut represents the body in motion: it is merely a wheel of six arms, made as light as possible, nicely balanced on a needle point at top. At the end of each arm is suspended a small piece of very thin brass. When each particular arm in the motion of the wheel comes to the positive pole, it becomes charged, and therefore repelled; the next arm is soon attracted and repelled in the same manner; and immediately afterwards the third arm. While this is approaching the positive pole, the first is attracted at the opposite side, where it deposits its load, and proceeds onward for another; and thus the motion is continued, entirely independent of

any agency but its own, and even overcoming the resistance of the air which it must meet with in its revolution. It is much influenced by the weather, moving faster or slower according to the electrical state of the atmosphere, and other causes not at present ascertained.

EFFECT OF HYDROGEN ON SOME SALTS OF SILVER.

BY WOHLER.

SOME researches on the peculiar mode of composition of metallic acid, have caused me to observe that the salt of silver of this acid, exposed to pure hydrogen gas at 202°, very quickly changed from its white color to black, and was afterwards soluble in water, and imparted a deep red color to it. During this reaction a little water was formed, and it lost oxygen, equal to half the weight of that contained in the oxide. The brown solution of the altered salt was strongly acid, and deposited after some time bright metallic silver, and became colorless; it then contained merely the common colorless salt dissolved in free acid.

This circumstance indicated with great probability, that by the action of the hydrogen upon this salt, the silver was reduced to the state of protoxide, a supposition which was completely confirmed by examining into the modes in which with other salts the existence of a protoxide of silver was satisfactorily determined.

Of some other salts of silver which I carefully examined with this view, the nitrate was that which evinced the most evident alteration. When exposed at 212° to a current of dried hydrogen gas, it becomes throughout the mass, and very quickly, of a deep color. The action even begins at common temperature, as it does with the melitate. The mass is then a mixture of nitrate of protoxide and free nitric acid. Half of the oxygen of the oxide of silver is disengaged in the state of water, from two atoms of the salt of the deutoxide. Water dissolves the free acid, and as soon as the principal part of this is removed, the protosalt begins to dissolve in the pure water with a deep red color. In the dry state this salt is a powder of a deep brownish black color. When heated it decomposes with a much weaker detonation than the white deutosalt. It then leaves 75 per cent. of metallic silver.

If the red solution of the protosalt be boiled, it gradually decomposes with a slight disengagement of gas; it becomes opalescent and of a peculiar yellowish green color; afterwards it deposits metallic silver, and becomes colorless. The brown protosalt dissolves in ammonia also with a very deep yellowish red color. When heated the solution undergoes a decomposition similar to the preceding. Sometimes the sides of the vessel are covered with a brilliant metallic coating almost of a golden color, and which like very finely divided gold, is transparent, and of a fine green color.

Potash precipitates a perfectly black heavy powder from the red solution of the protosalt, which is rendered colorless at the same time. This black powder is obtained also by the direct decomposition of the dry salt by means of a solution of potash; this precipitate remains black after drying; by pressure it becomes of a deep metallic lustre, and by heat is reduced to metallic silver, evolving oxygen. The black color seems to indicate that it is pure protoxide of silver; but this supposition does not always depend on the color, for this powder might also be, consistently with its properties, an intimate mixture of deutoxide of silver, and metallic silver, to which the protoxide may have given rise at the moment of its separation. It is also decomposed by the acids into metal and deutosalts, and ammonia exerts a similar action. Hydrochloric acid converts it into a brown substance, which is a chloride corresponding with the protoxide, or perhaps merely a mixture of silver and common chloride of silver; this substance is also obtained in the state of a brown, curdy precipitate, which speedily subsides, by precipitating the red solution of protonitrate of silver by hydrochloric acid; it acquires the metallic lustre by pressure. When heated to the temperature at which chloride of silver fuses, it becomes merely a yellow mass, and is a mixture of silver with the common chloride. When treated with ammonia, or even with concentrated solution of the hydrochlorate, the brown chloride is decomposed immediately into chloride which is dissolved, and into metallic silver which remains.

Oxalate of silver when exposed at 212° to the action of hydrogen gas, becomes of a bright yellow tint; but the decomposition seems to remain only partial at this temperature. It became brown at 281°; but it soon afterwards produced a very loud explosion. Succinate of silver becomes lemon yellow at 212° in hydrogen gas. At a higher temperature, half of the succinic acid sublimed. The protosuccinate of silver thus formed is insoluble in water. Pure deutoxide of silver is reduced to the metallic state precisely at 212° in hydrogen gas.—*Journal de Pharm. Juillet*, 1839.

PAINTING TRANSPARENCIES.

THE paper (or other material) must be fixed in a straining frame, in order to place it between the eye and the light, when required. After tracing the design, the color must be laid on, in the usual method of stained drawings. When the tints are got in, place the picture against the window on a pane of glass framed for the purpose, and begin to strengthen the shadows with Indian ink, or with colors, according as the effect requires; laying the colors sometimes on both sides of the paper, to give greater force and depth of color. The last touches for giving final strength to shadows and forms, are to be done with ivory black or lamp black prepared with gum water, as there is no pigment so opaque and capable of giving strength and decision. When the drawing is finished, and every part has got its depth of color and brilliancy, being perfectly dry, touch very carefully with spirits of turpentine, on both sides, those parts which are to be the brightest, such as the moon and fire; and those parts requiring less brightness, only on one side. Then lay on immediately, with a pencil, a varnish, made by dissolving one ounce of Canada balsam in an equal quantity of spirit of turpentine. Be cautious with the varnish, as it is apt to spread. When the varnish is dry, tinge the flame with red lead and gamboge, slightly touching the smoke next the flame. The moon must not be tinted with color. Much depends upon the choice of a subject. The great point to be attained is a happy coincidence between the subject and the effect produced. The fire light should not be too near the moon, as its glare would tend to injure her pale silver light; those parts which are not interesting should be kept in an undistinguishable gloom; and where the principal light is, they should be marked with precision. Groups of figures should be

well contrasted; those in shadow crossing those that are in light, by which means the opposition of light against shade is effected.

MOUNTING MICROSCOPIC OBJECTS.

To the Editor.

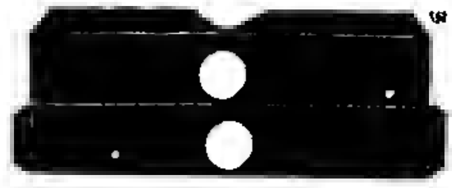
Sir.—It is much to be regretted that many persons, who might amuse and instruct themselves and others by the examination of microscopic objects, are deterred from purchasing microscopes merely on account of the enormous prices that are generally charged at the opticians for objects. They are not aware that with very little trouble they may prepare nearly all objects for themselves, and in many cases in a much better manner than those they could purchase, because they can devote more time and care to them than those who sell them can afford. In the hope of inducing many who have been prevented by the above reason from pursuing an amusement of so much interest and utility, I propose from time to time, through the medium of this journal, to furnish such instructions for the removal of all difficulties as my experience points out. According to the nature of the objects to be mounted, so must be the method of mounting them be conducted. The common kinds such as fish scales, hairs, textile fabrics, the antennæ, legs, and wings of insects, pollen of flowers, &c. require no particular care, they need merely to be placed within usual sliders; these are of two kinds, ivory or wood, metal and glass. I shall describe them all.

The *Ivory Slider* consists of a thin piece of ivory, having a convenient number of holes drilled in it, each hole having a slight shoulder to it, so that it is rather smaller on one side of the ivory than on the other, owing to which a piece of talc, glass, &c. fitting the hole on one side, will not fall through. One of these sliders is represented in the following figure:—

To mount the objects in it, there will be necessary some pieces of talc, made of the proper size and circular form by being punched out of a thick piece of talc, with one of the hollow punches sold at the tool shops, about three-eighths or half an inch in diameter. The talc when punched out may be easily split in very thin pieces by means of a penknife. Procure also some rings made by winding small brass wire round a thin stick, so as to make a coil. Cut this coil across lengthwise, and it will make as many rings as there were coils. These rings will open a little, and it is requisite they should; fit one of them to one of the holes of the slider; if it will go in and remain firm without the ends wrapping over each other it will do—if they lap over, cut a little bit off one end. These being prepared, and it will take less time to form them than to describe the method, proceed to mount the selected object, by putting first into one of the holes of the slider, a thin slice of talc—then at the top of this the object—upon the object a second thin slice of talc—and then one of the wire rings, which having a spring in it, will hold the talc tightly down by its edge resting against the shoulder formerly spoken of.

Wooden Slides are of precisely the same formation, but are usually made larger, and have glass instead of talc; they are chiefly used to hold the wings and other parts of the larger insects, sea weeds, &c.—when they are intended to be exhibited by the solar, the lucernal, or the oxy-hydrogen microscope—and also for many natural or artificial objects, exhibited by the magic lanthorn.

Metal Sliders.—A useful slider for a single object may be made in a minute, of a slip of very thin brass or tin—cut the brass, and punch two holes in it thus:—



Fold it at the central line—and then lay within the fold two very thin pieces of talc, with the object exactly opposite the hole which is cut in the brass—(it will be seen that there are two holes cut in the brass, but this being folded but one hole will be seen.) The object being properly placed, fold over the projecting ends and rim of the sheet of brass, which will keep the whole together firmly, and form a useful, though small slider, represented in the following cut:—

Glass Sliders.—To make these, a number of small slips of glass, (such as the glaziers cut off when putting a pane in a window,) should be procured. The size should be about ½ or ¾ of an inch in width, and of any length whatever. These can be bought for a mere trifle—for instance, 20 or 30 of such pieces for a few half-pence. Have by you a number of pieces of dark colored paper and card of various thicknesses, which gum on both sides and allow to dry. A small piece of hard flint, having a sharp corner, will be all that is then required. Having properly prepared your objects, cut off a piece of the glass, any convenient length, by making a scratch across it with the flint at the place where you wish it to break, and then snap it with the fingers as the glazier does after cutting with the diamond; it will scarcely ever fail to break in the right place. Proceed in the same way to cut another piece, exactly the same size as the first, and select a piece of your paper that is already gummed and dry, as nearly of the thickness of the object you desire to preserve as possible, and with the punch mentioned before cut one or more holes in it. Wet one side of the paper with the tongue and lay it smoothly on one of the pieces of glass, so that the holes in the paper will be as nearly as possible along the centre of the glass, and cut off all the paper that projects beyond the edges of the glass, which should previously be wiped very clean with a piece of wash leather. Wet the other side of the paper, taking care not to soil the part of the glass left uncovered by the holes in it; place your objects into the centre of these holes; lay the other glass neatly over it, so that the edges of the glasses shall coincide, and press them gently together, remembering that all the objects must be nearly of a thickness, and each put into its place before the second piece of glass is fixed. It is most convenient when using them, that *each object* should be on a *separate* slider; but, of course, it takes

rather more time as well as materials than to make them with several in one slider, except thet when the same object is to be seen under different circumstances, the sama slider is to be preferred. For objects thet are to be viewed by a lene of very high power, so that its focal length is less than the thickness of the glass, pieces of very clean talc must he used instead of *one* of the pieces of glass for the slider; but it is not so good in general for sliders, inasmuch as it is very ept to get scratched with the slightest friction. Telc, or Mica, can be procured at most opticians; but very much cheaper st Messre. Knights, Ironmongers, 41, Foster Lane, Cheapside. It can be easily divided into thin luminæ with the fingers, and none but the clearest pieces should be used, as it rendere the object indistinct if there are any blemishes in it.

Mounting opaque objects on diece, end trensparent ones in Ceneda balsam, will form the subject of a future peper.

AN AMATEUR.

SCREW CUTTING IN THE LATHE.

Having secured the substance, wood or metal, that is to be opereted upon, in the most convenient manner to the chuck—beer in mind thet a pin is less difficult to fit to a hole, than e hole is to e pin—therefore the operation will he commenced by making an aperture to near the diameter reqnired for the interior, or female screw. Secure the *tee*, (as the *rest* is technically called,) squere with the bed of the lathe, and at a height e little above the centre of the work. Lay your *arm rest*, (an iron bar turned up at one end, and the other held in a handle of fourteen or sixteen inches in length,) across the tee, and hold the extremity of the handle secure under your left arm-pit. Now put the work in e gentle motion, so that the treadle may rise and fall in ebout a second. Enter the female screw tool, (the tool that has its teeth on the edge or side, at the moment you depress the treadle. Let the tool enter a very little below the centre of the hole, and work on the near side. Resting the screw tool on the end of the erm rest, keep it np to its work, and not force it onward too rashly, but as it proceede moderately, rise the teeth gradually above the centre of the hole, hy the time the tool has reached the necessary depth. Repeat this motion as often as it may he required, or until a perfect worm on the interior is formed. The amateur not unfrequently forms a double and treble worm, by proceeding too hastily to work, which, of course, is uselees, end lebour in vain, while a single and correct worm only requires care and attention to perfect almost instantaneously.

The mele screw ie perfected by a similar motion, without the arm rest, first easing the sharp edge off the pin, and meking it smallest at tho backside.

R. L. PACKER.

Sept 5th, 1839.

RAILWAYS.

(Resumed from page 182.)

Chairs. Fastenings.—In describing the rails, the supports or chairs, have heen partly described. They are of iron, with e hroad, flat base, supported upon blocks of stone, into which holes are drilled, and filled with wooden plugs. The chairs are fastened to the stone blocks hy nails driven into these plugs. This stone block should rest firmly upon its base, and not be liable to change of position by frost or any other cause; and, accordingly, great care has been taken to make these snpports firm.

Turn-outs.—If all the waggons upon e rail-road, whether for the transportation of passengere or merchandise, were to travel at the same time, and at the same speed, two sets of trects would he sufficient to acommodate tha whole, as there would be no necessity for their turning ont to pass each other. But in the transportation of passengers, greater speed is desirable than in the transportation of merchandise; for the transportation of merchandise, whether by horse power or steam power, can be done more economically, and with less injury to the roed, at e low then a very high rate of speed. It is, therefore, s very considereble object, in rail-roade upon linee of public travel, to allow waggons to pass othere travelling in the same direction. Provision must he made, ecoordingly, for turning out. This provision is particulsrly necessary in case of a road with a single set of tracks, on which the carriages must meet. These turn-onts are mede hy means of a moveable or switch rail et the angle where the turn-ont track branches from the main one. This rail is two or three feet more or less, in length, end one end may he moved over thet angle, end leid so as to form a part of the main track, or the turn-out track. The switch rail is usually moved hy the hand, so as to form a part of thet track on which the waggon is to move.

Carriages. Wheels.—The bodies of the waggons will, obviously, require to be constructed with reference to the kind of transportation. The principal consideration, in regard to the construction of the carriages, relates to their hearinge on the axle and the rim of the wheel. The rule given hy Mr. Wood, as to the hearing on the axle, is, that in order to produce the least friction, the hreadth of the hearing should be equal to the diameter of the axle et the place of bearing. This diameter must he determined hy the weight to he cerried; end the hreadth of the bearing will accordingly vary with it. The objection to the plate rail, as already stated, is, thet the hreadth of the bearing of the rim of the wheel npon such a rail, causes an unnecessary additional friction; and the resistance to the wheel is increased in consequence of the greater liability of such a rail to collect dust and other impediments upon its surface. The edge rail is preferehle, in these reepects; but, at first, these rails were liable to one difficulty, in consequence of their wearing grooves in the rim of the wheel, so that the friction was continually increasing, end the wheel soon became unfit for use. To remedy this defect, the rims were case-hardened, or chilled, hy rolling them, when hot, against e cold iron cylinder. Wheels so case-hardened are fonnd to be subject to very little wear. It was, at first, objected to the use of iron wheels, that they would not take sufficiently strong hold of the rails to draw any considerehle load after them, and that therefore they would not answer for the use of locomotive engines. Where horses are the motive power, it is evident that if the horse draws the car to which he is attached, the others fastened to it must follow it being no objection that either the wheels of the carriage to which the horse is harnessed, or of those of the train following, do not take hold of the rails, but, on the contrary, the lees hold they take, the more easy it will be to move the train. But where one carriage is impelled forward by the

action of the engine in turning the wheels, and the following train of waggons is drawn by the engine car, if the resistance by gravity and friction is greater than the force with which the wheels adhere to the rails, the engine will only revolve the wheels to which it is geared, which would turn upon the rails and the car and the whole train remain stationary. To prevent this, different contrivances were heretofore resorted to, one of which was to let teeth project from the sides of the wheels to interlock with rack-work on the side of the rail. It has, however, been found, in practice, that, for the ordinary inclinations of railroads to the extent of about thirty feet per mile, the wheels may be so constructed as to move a train of waggons by their mere adhesion to the rails. The inclination which can be so overcome must evidently depend on the kind of surfaces of the rim of the wheel and the rail, the weight bearing upon the wheels, the weight to be moved, and the resistance from the friction of the train waggons; so that no precise rule can be given that shall be applicable to roads and wheels of different materials and construction. One of the first expedients for increasing the adhesion of the wheels to the rails, without incurring any considerable loss by additional weight or friction, was to gear the four wheels of the engine car together, so as to have the advantage of the friction of all of them upon the rails; for, if the piston of the engine is connected by gearing only with the wheels of an axle, a resistance in the other wheels of the engine, and by the wole train, only equal to the friction of those two wheels, can be overcome. By gearing the piston of the engine with the four wheels, by means of an endless chain passing round the two axles upon two cog-wheels, or by otherwise gearing the four wheels together or to the piston, the hold of the wheels on the rails is doubled. For the same purpose, an additional set of wheels, making six in the whole, for the engine car, is sometimes added; but such an addition to the number of sets of wheels is evidently attended with disadvantage on the score of expense, complication of structure, weight to be moved, and friction of parts to be overcome. The advantage proposed by adding another set of wheels is, that a greater weight may be carried by the engine car, thus making a greater adhesion to the rails by the wheels geared together, without throwing so great a weight upon any of the wheels as to injure the road. But resort is rarely had to this expedient. An improvement, having the same object, and attended by no loss from addition of weight or friction, is a contrivance for securing the adhesion of all the wheels to the rails; for it will be obvious that, if the two axles of the two sets of wheels are fastened to a strong unyielding car frame, the car will rest upon three wheels, whenever the surface of the road does not precisely correspond in relative altitude to the lower points in the rims of the wheels; that is, if the surfaces of the rails are precisely in the same plane, and the bearing surfaces of the rims of the wheels are also precisely in the same plane, all the wheels will rest upon and take hold of the rails, whether the axles are fastened to an unyielding frame or not. But no road or carriage can be so perfectly constructed, that the surfaces of the rails and bearings of the wheels can always exactly correspond. Mr. Knight, the chief engineer of the Baltimore and Ohio railroad, says, in his report of October, 1831, that the whole weight of a waggon, with an unyielding frame, will frequently be supported on two only of the four wheels, thus making a load bear twice as much upon one part of the rail, as it would do if its weight were equally supported by the four wheels. To remedy this difficulty, the whole weight carried upon the axles is supported by springs, or some interposed elastic power, that of the condensed steam being taken advantage of for the purpose in some cars, whereby each wheel is pressed upon the rail, through the relative surfaces on which the wheels may bear, on different places in the road, may vary. Mr. Knight, in the same report, makes a suggestion worthy of consideration in the construction of waggons as well as engine cars. He proposes that in all cases the weight should be supported on springs, not only for the purpose of distributing the weight equally, but also to prevent shocks and jars, whereby both the road and carriages are injured. Another expedient to secure a sufficient adhesion of the wheels to the surfaces of the rails, is to use wheels for the engine car that are not case-hardened.

The experiments stated by Mr. Tredgold and Mr. Wood, show a very great advantage in the use of large wheels. Mr. Wood states that the motive power required to overcome the same friction of rubbing parts of the car and engine, in case of wheels four feet in diameter, is less by one fourth than in case of those three feet in diameter. But there is some limit to the extent of this advantage for an increase of the diameter of the wheel add to the weight, and the expense of construction, s that wheels of not more than four or five fe in diameter are ordinarily used, and a great pa of those in use are not above two and a half feet Some of the locomotives used on the Liverpoo and Manchester railroad have sets of wheels i different sizes, the diameter of one being nearl double that of the other. The state of the ra will have some effect upon the adhesion of th wheels, which is least when the wheels are slightly wet. The experiments of Mr. Booth, on the Liverpool and Manchester railroad, prove that in the most unfavorable state of the rails, the adhesion of wheels of malleable iron upon rails of the same material, is equal to one twentieth of the weight upon them. The locomotives vary in weight, from three or four to ten or eleven tons. A locomotive with its apparatus and appendages, weighing four and a half tons, will adhere to the rails with sufficient force to draw thirty tons weight on a level road, at the rate of fifteen miles per hour, and seven tons up an ascent of one in ninety-six, or fifty-five feet in a mile; at a slower rate, it will draw a greater weight. The slower the rate of travelling is, the greater is the weight that may be supported by the same wheel, without injury to the road from shocks, though the weight must of course be limited by the size and strength of the rails, whether the rate of motion be quick or slow.

(Continued on page 214.)

ENGRAVING BY VOLTAIC ACTION.

BY DR. M. H. JACOBI,

In a Letter to Mr. Faraday.

It is some time since, that during my electro-magnetic labours a fortunate accident conducted me to the discovery that we might by voltaic action make copies in relief of an engraved copper plate, and that a new inverted copy of those in relief might be obtained by the same process, so that the power

was obtained of multiplying the copper copies to any extent. By this voltaic process, the most delicate and even microscopic lines are reproduced, and the copies are so identical with the original that the most rigorous examination cannot find the least difference. I send you in the accompanying packet two specimens of such plates, which I hope you will accept with kindness. The one which I is in relief is the copy of an original engraved with the graver; the second is the copy of that in relief, and consequently identical with the original. The third is the original plate, but covered with reduced copper. I had the intention of making a second copy, but unfortunately the plates adhere so strongly at times that it is impossible to separate them. I cannot tell the cause of this intimate union which occasionally occurs, but it appears to be the case only when the copper at the surface of which the reduction is effected is brilliant, and consequently is lamellar and porous. I may dispense with describing more at large the apparatus that I make use of. It is simply a voltaic pair, where the engraved plate is used in the place of the ordinary copper plate, being plunged in the solution of sulphate of copper. I have found it necessary that a galvanometer with short wires should always make part of the circuit, so that one may judge of the force of the current and direct the action; the latter being effected by separating the electromotive plates more or less from each other, or modifying the length of the conjunctive wire, or finally, diminishing more or less the conducting power of the liquid on the zinc side: but for the success of the operation it is of great importance that the solution of copper should be always perfectly saturated. The action should not be too rapid; from 50 to 60 grains of copper should be reduced on each square inch in 24 hours. The accompanying plates have been formed, one in two days, the other in one day only, and that is the reason why their state of aggregation is not so solid and compact as that of the small piece, No. 4, which has been reduced more slowly.

It is to be understood that we may reduce the sulphate of copper by making the current of a single voltaic pair pass through the solution by copper connecting wires; as the anode is oxidized the cathode* becomes covered with reduced copper, and the supply of concentrated solution may then be dispensed with. According to theory one might expect that exactly the same quantity of copper, oxidized on one side would be reduced on the other, but I have always found a difference more or less great, so that the anode loses more than the cathode gains. The difference appears to be nearly constant, for it does not augment after a certain time, if the experiment be prolonged. A thoroughly concentrated solution of sulphate of copper is not decomposable by electrodes of the same metal, even on employing a battery of three or four pairs of plates. The needle is certainly strongly affected as soon as the circuit is completed, but the deviation visibly diminishes and very soon returns almost to zero. If the solution be diluted with water to which a few drops of sulphuric acid have been added, the current becomes very strong and constant, the decomposition goes on very regularly, and the engraved cathode becomes covered with copper of a fine pink red color. If we replace the solution of sulphate of copper by pure water acidulated with sulphuric acid; there is a strong decomposition of water even on employing a single voltaic couple. The anode is oxidized, and hydrogen is disengaged at the cathode. At the commencement the reduction of copper does not take place; it begins as soon as the liquid acquires a blue color, but its state of aggregation is always incoherent. I have continued this experiment for three days, until the anode was nearly dissolved; the color of the liquid became continually deeper, but the disengagement of hydrogen, though it diminished in quantity, did not cease. I think we may conclude from this experiment that in secondary voltaic actions there is neither that simultaneity of effect, nor that necessity of entering into combination or of being disengaged from it, which has place in primary electrolytic actions.

During my experiments many anomalies respecting these secondary actions have presented themselves, which it would be too embarrassing to describe here: in fact there is here a void which it will be difficult to fill, because molecular forces, which as yet we know nothing of, appear to play a most important part.

With respect to the technical importance of these voltaic copies, I would observe that we may use the engraved cathode, not only of metals more negative than copper, but also of positive metals and their alloys, (excepting brass,) notwithstanding that these metals, &c. decompose the salts of copper with too much energy when alone. Thus one may make, for example, stereotypes in copper which may be multiplied as much as we please. I shall shortly have the honor to send you a bas-relief in copper, of which the original is formed of a plastic substance, which adapts itself to all the wants and caprices of art. By this process all those delicate touches are preserved which make the principal beauty of such a work, and which are usually sacrificed in the process of casting, a process which is not capable of reproducing them in all their purity. Artists should be very grateful to galvanism for having opened this new road to them.

* The ANODE and CATHODE signify the two poles of the battery, or the positive and negative ends of it.—Ed

MISCELLANIES.

Water rendered Colder than Ice.—Put a lump of ice into an equal quantity (by weight) of water heated to 170 degrees; the result will be that the fluid will be no hotter than water just beginning to freeze, but if a little sea salt be added it will become colder than the ice was at first.

Thunder Storms.—In Philipsthal, a village in Eastern Prussia, an attempt has been made to convert this terrible phenomenon to the use of society, by causing an immense stone to be shivered to pieces by the lightning. A bar of iron being fixed to it, in the form of a conductor, the experiment was attended with the most complete success, for during the very first thunder storm, the lightning burst the stone without displacing it.

New Blue Color from the Corn Cockle Flower.—Pick the dark blue leaves from the centre of the flower on the same day they are gathered, or as soon as possible. A sufficient quantity of these middle leaves being procured, press out what juice you can from them, and add to it a little alum, and you will have a lasting transparent color, scarcely inferior to ultramarine.

The best time for gathering these flowers is in June or July though some few may be found in May, but whenever they are gathered observe to

pick out the middle deep blue flower leaves, and express the juice as soon as possible afterwards or the color will lose its perfection. This flower, which is the *Centaurea Cyanus* of Linnæus, is also called Corn Blue Bottle, and may be found in most corn fields.

"The blue Cyanus we will not forget,
'Tis the pride of the harvest coronet."

To obtain Potassium.—A thin piece of hydrate of potassa is placed between two discs of platina, connected with the extremities of a voltaic apparatus of 200 double plates; it will soon undergo fusion, oxygen will separate at the positive surface, and small globules will appear at the negative surface, which consist of potassium. I discovered this metal in the beginning of October, 1807.—SIR H. DAVY.

One hundred two-inch plates of a Cruikshank's battery decomposes the potassa very well. If the battery be too active the liberated potassium is apt to take fire.

Echoes.—The following are among the most remarkable. At Rosneath, near Glasgow, there is an echo that repeats a tune played with a trumpet three times completely and distinctly. Near Rome there was one that repeated what a person said five times. At Brussels there is an echo that answered fifteen times. At Thornbury Castle, Gloucestershire, an echo repeats ten or eleven times very distinctly. Between Coblentz and Bingen an echo is celebrated as different from most others. In common echoes the repetition is not heard till some time after hearing the words spoken or notes sung. In this the person who speaks or sings is scarcely heard, but the repetition is perceived very clearly, and in surprising varieties, the echo in some cases appears to be approaching—in others receding; sometimes it is heard distinctly—at others scarcely at all; one person hears only one voice, while another hears several; and to mention but one more instance, in Italy, near Milan, the sound of a pistol is returned fifty-six times.

Cement for Derbyshire Spar and other Stones.—A cement for this purpose may be made with about seven or eight parts of resin and one of bees'-wax, melted together with a small quantity of plaster of Paris. If it is wished to make the cement fill up the place of any small chips that may have been lost, the quantity of plaster must be increased a little. When the ingredients are well mixed, and the whole is nearly cold, the mass should be well kneaded together. The pieces of spar that are to be joined, must be heated until they will melt the cement, and then pressed together, some of the cement being previously interposed. Melted sulphur applied to fragments of stones previously heated (by placing them before a fire) to at least the melting point of sulphur, and then joined with the sulphur between, makes a pretty firm and durable joining. Little deficiencies in the stone, as chips out of corners, &c. may be also filled up with melted sulphur, in which some of the powder of the stone has been melted.

Paper.—The art of making paper from rags is said to have been the invention of a Swiss at Basil in 1417, but Mr. Warton, in his History of English Poetry, traces it to a much earlier source. I believe the 11th century, and there are specimens among the Tower Records, which corroborate his opinion. We certainly have grants, conveyances, and other deeds and evidences in England, or at least have had, (and especially among the very ancient collections of Richard Gascoyne, Esq. that able antiquary who died about the time of the Restoration,) written upon paper that was as old as the Conquest, and it is not improbable but those quaternions of leaves stitched together whereof King Alfred so long before made his little *hand books* were also of paper, rather than parchment or vellum. John Tate, who is presumed to have flourished about 1496, is said to have first made paper in England, or was at the expense of introducing the manufacture, for evidence is produced that the English edition of Bartholemeus, printed by Wynkin de Worde was the first book, for any thing we yet know to the contrary, that was printed upon paper made in this nation. John Spilman had a patent for making paper from Elizabeth.—*Fosbrooke's Records of Gloucestershire.*

Hops.—Dr. A. W. Ives, of New York, has made many experiments on the hop, which prove that its characteristic properties reside in a substance forming not more than one-sixth part weight of the hop, and easily separable from it. It was observed, that on removing some hops from a bag in which they had been preserved for three years, an impalpable powder, (yellow,) was left behind, which when sifted, appeared quite pure—this has been called lupulin: it is peculiar to the female plant, and is probably secreted by the nectaria. Hops, from which all the lupulin has been extracted, when acted upon by water, alcohol, &c., gave a portion of extract which, however, possessed none of the characteristic properties of the hops. Dr. Ives next endeavoured to ascertain the quantity of lupulin afforded by a given weight of hops. Six lbs. of hops, from the centre of a pocket, were put into a light bag, and by thrashing, rubbing and sifting, 14 oz. were separated. 2 barrels of beer were then made, in which 9oz. of lupulin were substituted for 5lbs. of hops, and the result confirmed every expectation.

Fungin is a vegetable substance, extracted from mushrooms, of a fleshy appearance, perfectly tasteless, and of a highly nutritious quality. It is obtained by macerating the pulp of mushrooms in hot water, holding a little potass in solution—what remains undissolved is fungin.

To make Potent Cement.—A mixture of lime, clay, oxide of iron, separately calcined and reduced to fine powder, are to be intimately mixed. It must be kept in close vessels and mixed with the requisite quantity of water when used. This cement is useful for coating the joinings of the wood of which the pneumatic trough is composed, in order to render it water tight; and for other purposes of a like nature.

QUERIES.

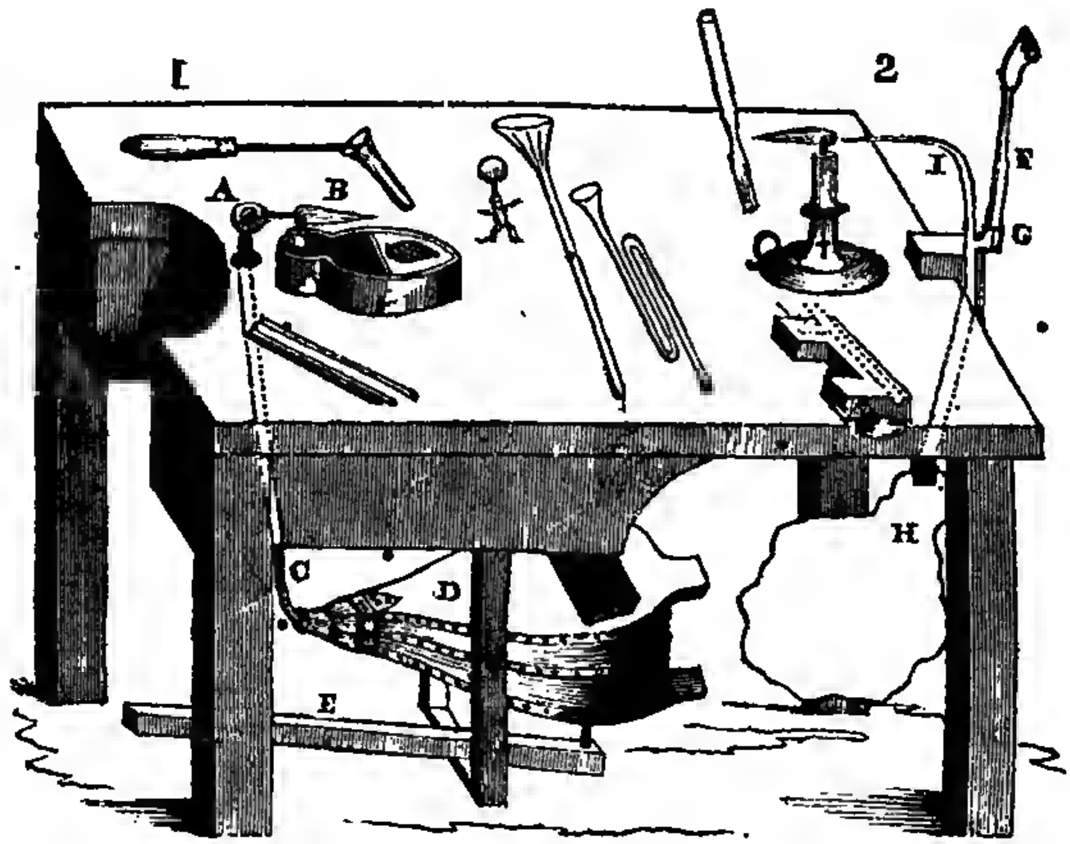
120—Is there a geometrical rule for obtaining an equilateral triangle equal to a given square, and in what author?—*Answered on page 359.*

121—How is ivory to be stained of various colors, and also how bleached when yellow by time?—*Answered on page 203.*

122—If a fresh egg be pressed longitudinally between the palms of the hands it will not break, while an addled egg breaks easily. Why is this?—*Answered on page 208.*

123—How is white marble best cleaned and whitened?—*Answered on page 232.*

124—What is the construction of the eccentric chuck?—*Answered on page 412*



THE GLASS BLOWER'S TABLE.

GLASS BLOWING.

STUDENTS, especially those who desire to exercise themselves in chemical manipulation, must feel the want of a simple and economical process, by means of which they could give to glass tubes, of which they make great use, the various forms that are necessary for particular operations. How much reason have they to complain of the high price of the instruments of which they make continual use? The studies of a great number are shackled from wont of opportunity to exercise themselves in monipulation; and many, not daring to be at the expense of a machine of which they doubt their ability to make on advantageous use, figure to themselves the employment of tha glase blower'e apparatus as beset with difficulties, and so rest without having even an idea of the numberless instruments which can be mode by its means.

Many persons would very willingly occupy their leisure time in practising the charming art of working glass and enamels with tho blow-pipe; but the anticipoted expenee of tbe apparatus, aod the difficnltles whicb tbey imagina they foresee io tha execution of work of this kind, always repele them.

This treatise is destined to teach them the eimplest, the most expeditious, the least expensive, and the most effectual methods of constructing for tbemselves the various instrnments which they require in the prosecution of their studies.

The word *glass-blower*, generally speking, signifies o workman who occnpies himself in making of glass and eoamel, the instrnments, vessels, and ornaments, which are fabricated on a larger scola in the glass-bouses: but the domoin of the sciences hoving laid the art of glass blowing under contribntion, the artists of the lamp hava divided the labour thereof. Some apply themselves particularly to the construction of philosophical instruments; others occupy themselves with little ornomental flowers, &c.: and, among the latter, some manufacture nothing but pearls, and others only ortificial eyes. Finally, a few ortists confine themselves to drswing and painting on enamel, which substance is previously applied to metallic eurfaoes by means of the fire of a muffle.

On seeing, for the first time, a glass blower ot work, we are ostonished at the multltnde ond the variety of the modifications to which he can make the glass euhmit. The small nnmber and the eimplicity of

the instruments he employs, is also surprising. The blow-pipe, or in its place, the glass blower's bellows and a lamp, are indeed all that are indispensable.

The Glass Blower's Table.—Artists give this name to an apparatus which consists of the following articles:—1. A *table*, below which is disposed a *double bellows*, capable of being put in motion by means of a pedal. This bellows furnishes a continued current of air, which can be directed at pleasure by making it pass through a tube terminating above the table in a sharp beak. The bellows with which the glass blower's tables are commonly furnished have very great defects. The irregular form which is given to the panels diminishes the capacity of the instruments, without augmenting their advantages. If we reflect an instant on the angle, more or less open, which these panels form when in motion, we instantly perceive that the weight with which the upper surface of a bellows is charged, and which always affords a vertical pressure, acts very unequally on the arm of a lever which is continually changing its position. This faulty disposition of the parts of the machine has the effect of varying every instant the intensity of the current of air directed upon the flame. All these inconveniences would disappear, were the upper pannel, like that in the middle, disposed in such a manner as to be always horizontal. It ought to be elevated and depressed, in its whole extent, in the same manner; so that, when charged with a weight, the pressure should be constantly the same, and the current of air uniform.

2. A *lamp*, of copper or tin plate.—The construction of this article has varied according to the taste of those who have made use of it. Nothing is better than a lamp with a common cotton wick, the wick itself being about half-an-inch in diameter.

Fig. 1 represents the blow-pipe with double bellows. A is the jet, which consists of a finely perforated tube, occasionally made moveable around a joint at A. B is the lamp flame, driven to a fine point by the draught of air, in which point the glass to be bent or blown is held. C is a tube connecting the jet with the bellows D below, which are worked by the treadle E, the bellows being loaded with a weight to force the upper board down, and thereby expel the air. The workman sits at the end of the table and works the treadle by his foot. The above is the usual construction of the table as used in England. The French, however, use a different apparatus, which is cheap, simple, effective, and occupies much less room, it is represented in Fig. 2. I is the jet made of a pipe of brass, connected with a tube which passes under the table to a bladder H; joined to this at any convenient part is a third tube F, opened at the upper end, and furnished at the lower end with a valve which opens downward. Upon blowing into the tube F, the bladder is filled with air, which cannot return through the tube F on account of the valve at G. It can therefore only escape through the jet, when it would be thrown upon the flame of a candle or lamp, and answer its intended purpose.

The workman, seated before the table where he has fixed his instrument, blows from time to time, to feed the reservoir or bladder, which being pressed by a system of strings stretched by a weight, produces an uniform current of air. The force of the current of air can be modified at pleasure, by squeezing the reservoir more or less between the knees.

Oil, Tallow, &c.—Among the substances which have been employed to feed the fire of the glass blower's lamp, those to which the preference is to be given are wax, olive oil, rape oil, poppy oil, and tallow.

Purified rape oil is that of which the use is most general. Next to olive oil and wax, it affords the greatest heat, and the least smoke. But, in a word, as in the working of glass, the operator has more need of a bright flame without smoke, than of a high temperature, any combustible may be employed which is capable of furnishing a flame possessing these qualities.

The Flame.—It is only by long habitude, and a species of routine, that workmen come to know, not only the kind of flame which is most proper for each object they wish to make, but the exact point of the jet where they ought to expose their glass. By analysing the flame, upon the knowledge of which depends the success of the work, we can immediately obtain results, which, without that, could only be the fruit of long experience.

Flame is a gaseous matter, of which a portion is heated to the point of becoming luminous; its form depends upon the mode of its disengagement, and upon the force and direction of the current of air which either supports its combustion or acts upon it mechanically.

The flame of a candle, burning freely in still air, presents in general the form of a pyramid. It consists of four distinct parts: the immediate products of the decomposition of the combustible by the heat which is produced, occupy the centre, where they exist in the state of an obscure gaseous matter, circumscribed by a brilliant and very luminous envelope; the latter is nothing but the obscure matter itself, in the circumstances where, on coming into contact with the atmosphere, it combines with the oxygen which exists therein, and forms what is properly called *flame*.

The blueish light which characterises the inferior part of the flame, is produced by a current of cold air, which, passing from below *upwards*, hinders the combustion from taking place at the bottom of the flame, at the *same* temperature that exists in the parts of the flame not immediately subject to this influence.

Finally, on observing attentively, we perceive a fourth part, which is but slightly luminous, and exists as an envelope of all the other parts of the flame. The greatest thickness of this envelope corresponds with the summit of the flame. From this point it gradually becomes thinner, till it arrives at the lowest part of the blueish light, where it altogether disappears. It is in this last-described portion of the flame that the combustion of the gas is finished, and there it is that we find the seat of the most intense heat which the flame of the candle affords. If we compare the temperature of the different parts of the flame, we find that the maximum of heat forms a ring which is the limit of the superior extremity of the blueish light.

When the flame is acted upon by the blow-pipe, it is subject to two principal modifications:—

1. If, by means of a blow-pipe with a very fine orifice you direct a current of air through the middle of the flame, you project a portion of the flame in the direction of the blast. The jet thus formed appears like a tongue of fire, blueish, cylindrical, straight, and very long; the current of air occupies its interior. This flame is enveloped on all sides by an almost invisible light, which, extending beyond the blue flame, forms a jet very little luminous, but possessing an extremely high temperature. It is

at the point which corresponds with the extremity of the blue flame, that the maximum of heat is found. The extreme point of the jet possesses a less degree of heat. This flame is adapted for mineralogical assays, for soldering, for working enamels, and in general for all small objects.

2. When the orifice of the blow-pipe is somewhat large, or when (the orifice being capillary), the current of air is very strong, or the beak is somewhat removed from the flame, the jet of fire instead of being prolonged into a pointed tongue, is blown into a brush. It makes then a roaring noise, and spreads into an irregular figure, wherein the different parts of the flame are confounded beyond the possibility of discrimination. This flame is very proper for the working of glass, and particularly of glass tubes; it ought to be clear and very brilliant, and above all should not deposit soot upon cold bodies suddenly plunged into it. The maximum of temperature in this flame is not well marked; we can say, however, that in general it will be found at about two-thirds of the whole length of the jet. As this roaring flame contains a large quantity of carburetted hydrogen, and even of vapour of oil, escaped from combustion, it possesses a disoxidizing or reducing property in a very high degree.

The lamp should be firmly seated upon a steady and perfectly horizontal table, and should be kept continually full of oil.

When you set to work, the first thing you have to do is to examine the orifice of the beak. If it is closed, or altered in form, by adhering soot, you must carefully clean it, and open the canal by means of a needle or fine wire. In the next place you freshen the wick by cutting it squarely, and carrying off with the scissars the parts which are carbonised. You then divide it into two principal bundles, which you separate sufficiently to permit a current of air, directed between the two, to touch their surfaces lightly, without being interrupted in its progress. By pushing the bundles more or less close to one another, and by snuffing them, you arrive at length at obtaining a convenient jet. It is a good plan to allow, between the two principal bundles and at their inferior part, a little portion of the wick to remain: you bend this down in the direction of the jet, and make it lie immediately beneath the current of air.

To obtain a good fire, it is necessary to place the lamp in such a position that the orifice of the blow-pipe shall just touch the exterior part of the flame. The beak must not enter the flame, as it can then throw into the jet only an inconsiderable portion of the ignited matter. On the one hand, if the lamp be too far away from the blow-pipe, the flame becomes trembling, appears blueish, and possesses a very low degree of heat.

For mineralogical experiments, and for operations connected with watch-making and jewellery, the current of air should project the flame horizontally. For glass blowing, the flame should be projected at an angle of twenty or twenty-five degrees.

The current of air ought to be constant, uniform, and sufficiently powerful to carry the flame in its direction. When it is not strong enough to produce this effect, it is necessary to add weights to the bellows or the bladder, according as the glass blowers table, or the French jet, is employed. The point to which you should apply, in the use of these instruments, is to enable yourself to produce a current of air so uniform in its course that the projected flame be without the least variation.

Finally, when you leave off working you should extinguish the flame, by cutting off the inflamed portion of the wick with the scissars. This has the double advantage of avoiding the production of a mass of smoke and of leaving the lamp in a fit state for another operation.

(Continued on page 243.)

BLEACHING AND DYEING IVORY.

Ivory is very apt to take a yellow-brown tint by exposure to air. It may be whitened or bleached, by rubbing it first with pounded pumice-stone and water, then placing it moist under a glass shade luted to the sole at the bottom, and exposing it to sunshine. The sunbeams without the shade would be apt to occasion fissures in the ivory. The moist rubbing and exposure may be repeated several times.

Ivory may be dyed by using the following prescriptions:—

1. *Black Dye.*—If the ivory be laid for several hours in a dilute solution of neutral nitrate of pure silver, with access of light, it will assume a black color, having a slightly green cast. A still finer black may be obtained by boiling the ivory for some time in a strained decoction of logwood, and then steeping it in a solution of red sulphate or red acetate of iron.

2. *Blue Dye.*—When ivory is kept immersed for a longer or shorter time in a dilute solution of sulphate of indigo (partly saturated with potash), it assumes a blue tint of greater or less intensity.

3. *Green Dye.*—This is given by dipping blued ivory for a little while in solution of nitromuriate of tin, and then in a hot decoction of fustic.

4. *Yellow Dye* is given by impregnating the ivory first with the above tin mordant, and then digesting it with heat in a strained decoction of fustic. The color passes into orange, if some brazil wood has been mixed with the fustic. A very fine unchangeable yellow may be communicated to ivory by steeping it 18 or 24 hours in a strong solution of the neutral chromate of potash, and then plunging it for some time in a boiling hot solution of acetate of lead.

5. *Red Dye* may be given by imbuing the ivory first with the tin mordant, then plunging it in a bath of brazil wood, cochineal, or a mixture of the two. Lac-dye may be used with still more advantage to produce a scarlet tint. If the scarlet ivory be plunged for a little in a solution of potash, it will become cherry red.

6. *Violet Dye* is given in the logwood bath, to ivory previously mordanted for a short time with solution of tin. When the bath becomes exhausted, it imparts a lilac hue. Violet ivory is changed to purple-red by steeping it a little while in water containing a few drops of nitro-muriatic acid.

With regard to dyeing ivory, it may in general be observed, that the colors penetrate better before the surface is polished than afterwards. Should any dark spots appear, they may be cleared up by rubbing them with chalk; after which the ivory should be dyed once more to produce perfect uniformity of shade. On taking it out of the boiling hot dye bath, it ought to be immediately plunged into cold water, to prevent the chance of fissures being caused by the heat.

THE DOCTRINE OF CATALYSIS.

Of the various hypotheses that have been from time to time advanced, with a view to account for some of the secret operations of nature, none afford a wider field for speculation and research than an investigation of the doctrine of catalysis. Without advocating the real existence of such an agent, which can be only recognized by its effects, I shall proceed to illustrate the arguments of those chemists who are inclined to adopt this theory. When a jet of hydrogen gas is directed against a piece of spongy platinum, (which is the principle of Dobereiner's lamp,) the metal soon becomes ignited, and thus inflames the gas; the result of this is the formation of water, derived from a combination of the oxygen of the atmosphere with hydrogen. So far the result is perfectly conformable with the established principles of chemistry—but when the platinum is examined it is found unaltered—no oxidation has occurred, nor has it lost weight; and the same experiment may be performed over and over again. In such a case, (say they who place confidence in this doctrine), the metal causes chemical combination between the gases, by the action of contact, or catalysis. This, however, is, without doubt an inferior explanation to that offered by Mr. Faraday, who accounts for it by referring the action to an adhesive attraction of the two gases for the same metal, upon the surface of which they enter into direct contact, and by which they are enabled to combine. The catalytic influence appears to be developed rather in processes of decomposition than combination, and bodies in which it exists exert their power in effecting changes, without entering into combination with either the compound body, or its constituents, when decomposed. An excellent illustration of this is afforded in the process of fermentation: it is well known that when sugar, water, and yeast, are exposed for a few hours to a temperature of about 70° Fah., carbonic acid gas is evolved, and alcohol formed; yet the yeast remains undiminished in quantity, nor can chemical analysis detect in it the least change; it has caused the principles with which it was in contact to assume new forms, but itself remains the same. The pressure of atmospheric air is not at all essential to these changes, therefore its agency cannot be regarded in explaining the phenomena: the constitution of the ferment itself is imperfectly understood, but it is supposed that it owes its power to a minute proportion of gluten. This substance, to which is attributed a catalytic influence, has an elastic texture, and a grey color: it exists to the extent of 20 per cent. in good wheat flour, and is found to contain nitrogen, hence it is somewhat allied to an animal production. As a proof that the presence of some principle analogous to yeast is necessary for fermentation, it may be mentioned, that a solution of sugar, placed in the most favorable situations, can never be made to acquire a vinous taste without its addition. At one time, must, (the juice of the grape,) was thought to militate against this view, as it ferments spontaneously, but a substance allied to gluten has been detected in it, and is supposed to exist in the juices of all fruits.

Another illustration of this doctrine is seen in the conversion of starch into gum and sugar, under the influence of *diastase*. When starch is subjected to a heat of 280°, it gradually assumes the properties of a gum, and becomes mucilaginous: it then forms British gum, much used by calico printers for thickening their mordants. When thus altered, it is called by chemists *dextrine*, from the effects of its solution on polarized light. From starch has been separated a viscid ductile substance, called *diastase;* in its physical characters it is analogous to gluten, and like the latter, is supposed to possess catalytic influences, for it converts starch from a gelatinous into a mucilaginous substance, (dextrine,) and at a still higher temperature into sugar. This remarkable substance exists in germinating barley, and, perhaps contributes to render it saccharine, a preliminary step to fermentation. If starch be boiled in diluted sulphuric acid for some time, the same effect is produced as that attributed to diastase. No apology I conceive is required if one more example of the effect of this mysterious agent be adduced: it is a well known fact, that hydrocyanic, or prussic acid, is found in the bitter almond after it has been distilled at a gentle heat; this violent poison does not, however, exist in it originally, but is the result of a decomposition of its elementary principles, and their assumption of new forms: the peculiar flavor of the almond depends on a neutral principel, called amygdalin; when this is distilled by itself no decomposition takes place, but if a small quantity of another neutral substance, called *emulsine*, be present, a catalysis occurs, and the amygdalin is resolved into a variety of substances, the atomic weight of which combined is found to be equal to that of the amygdalin. One of the substances thus produced is hydrocyanic acid: in this instance we see that the emulsine plays a part similar to that of gluten and diastase.

Before quitting the consideration of this doctrine, let us consider the position in which it deserves to be placed. It must be obvious to its warmest advocates that it is open to many and serious objections, as all theories necessarily must be which are insufficient to account for the phenomena connected with them; still there is much in the subject of catalysis which requires long and patient investigation, and those disposed to cavil should remember that it is much easier to upset an unsatisfactory theory than to substitute a better in its place. Notwithstanding this opinion let me not be imagined to argue in its favor, for after reviewing the different illustrations above given I am driven to the conclusion that we must receive its supposed effects with jealousy and caution, and regard them as a pleasing fiction rather than as a satisfactory explanation. It cannot have escaped observation that this action is rarely or never developed without the presence of caloric; not to mention the effects of the spongy platinum, which are explained in a much more philosophical way than referring to catalysis. These are three examples in all which heat plays a prominent part: in fermentation, for instance, the temperature is much raised, and until this occurs no sensible evolution of carbonic acid gas takes place. The intimate connection between the production of this gas, and an increase of temperature, has been previously noticed in this work, (page 75.) May not this natural generation of heat produce those effects, which are ascribed to the action of contact? And, if this be admitted, a like conclusion may be drawn for the other cases, which are to a certain extent nothing but varieties of fermentation. Again, the agent diastase is inert, until the temperature is raised to 280°, or the starch be boiled in sulphuric acid, in both which processes it need not be said caloric is developed; nor has the emulsine, though present, any decomposing influence over the amygdalin, until

is distilled at a *gentle heat*. These and many more objections might be urged did space allow: enough has been said to direct inquiry into the proper channel, and if this paper be instrumental in inducing any of the readers of this Magazine to turn their attention to the doctrine of catalysis its end is attained.

W. PRESTON.

STONES USED IN THE ARTS.

BY R. KNIGHT, ESQ. F.G.S.

The stones used in the arts may be divided into two classes, those used as materials, such as marbles, porphory, &c., and those used as tools, or for grinding, pulverising, and polishing, or sharpening edged tools, and other articles. The latter class is properly divided into those of a sand-stone nature, and those similar to slate. The following is a synopsis of the chief kinds.

SANDSTONES.

Grit or Sandstone—Of this variety the universally known and justly celebrated Newcastle grindstones are formed. It abounds in the coal districts of Northumberland, Durham, Yorshire, and Derbyshire; and is selected of different degrees of density and coarseness, best suited to the various manufactures of Sheffield and Birmingham, for grinding and giving a smooth and polished surface to their different wares. A similar description of stone, of great excellence, and which is of a lighter color, much finer, and of a very sharp nature, and at the same time not too hard, is confined to a very small spot, of limited extent and thickness, in the immediate vicinity of Bilston, in Staffordshire, where it lies above the coal, and is now quarried entirely for the purpose of grindstones.

A hard close variety, known by the name of carpenter's rub-stone, is used as a portable stone for sharpening tools by rubbing them on the flat stone instead of grinding. It is also much employed for the purpose of giving a smooth and uniform surface to copper-plates for the engraver.

There is a much softer variety of sandstone, usually cut into a square form, from eight to twelve inches long, used dry by shoe-makers, cork-cutters, and others, for giving a sort of coarse edge to their bladed knives, and instruments of a similar description. A variety called Yorkshire Grit, not at all applied as a whet-stone, is in considerable use as a polisher of marble, and of copper-plates.

HONE SLATES.

Norway Rag-stone.—This is the coarsest variety of the hone slates. It is imported in very considerable quantities from Norway, in the form of square prisms, from nine to twelve inches long, and one to two inches diameter, gives a finer edge than the sand stones, and is in very general use.

Charley Forest-stone is one of the best substitutes for the Turkey oil-stone, and much in request by joiners and others, for giving a fine edge, It has hitherto been found only on Charnwood Forest, near Mount Sorrel, in Leicestershire.

Ary-stone, Scotch-stone, or Snake-stone, is most in request as a polishing stone for marble and copper-plate; but the harder varieties have of late been employed as whet-stones.

Idwall, or Welsh Oil-stone, is generally harder, but in other respects differs but little as whet-stone from the Charley Forest; but in consequence of its being more expensive, is in less general use. It is obtained from the vicinity of Llyn Idwall, in the Snowdon district of North Wales.

Devonshire Oil-stone is an excellent variety for sharpening all kinds of thin-edged broad instruments, as plane-irons, chisels, &c., and deserves to be better known. This stone was first brought into notice by Mr. John Taylor, who met with it in the neighbourhood of Tavistock, and sent a small parcel to London for distribution; but for want of a constant and regular supply, it is entirely out of use here.

Cutler's Green-hone is of so hard and close a nature, that it is only applicable to the purposes of cutlers and instrument-makers, for giving the last edge to the lancet, and other delicate surgical instruments. It has hitherto been only found in tha Snowdon Mountains of North Wales.

German Razor-hone.—This is universally known throughout Europe, and generally esteemed as the best whet-stone for all kinds of the finer description of cutlery. It is obtained from the slate mountains in the neighbourhood of Ratisbon, where it occurs in the form of a yellow vein running virtually into the blue slate, sometimes not more than an inch in thickness, and varying to twelve and sometimes eighteen inches, from whence it is quarried, and then sawed into thin slabs, which are usually cemented into a similar slab of the slate, to serve as a support, and in that state sold for use. That which is obtained from the lowest part of the vein is esteemed the best, and termed old rock.

A dark slate of very uniform character; in appearance not at all laminated; is in considerable use among jewellers, clock-makers, and other workers in silver and metal, for polishing off their work, and for whose greater convenience it is cut into lengths of about six inches, and from a quarter of an inch to an inch or more wide, and packed up in small bundles from six to sixteen in each, and secured by means of withes of osier, and in that state imported for use, and called blue polishing stones.

Grey Polishing-stone is of very similar properties, but of a somewhat coarser texture and paler colors. Its uses are the same, and they are manufactured near Ratisbon.

A soft variety of hone-slate is confined to curriers, and by them employed to give a fine smooth edge to their broad and straight-edged knives for dressing leather. They are always cut of a circular form, and are called Welsh clearing stones.

Turkey Oil-stone—This stone can hardly be considered a hone-slata, having nothing of a lamellar or schistose appearance. As a whet-stone, it surpasses, every other known substance, and possesses, in an eminent degree, the property of abrading the hardest steel, and is at the same time of so compact and close a nature, as to resist the pressure necessary for sharpening a graver, or other small instruments of that description. Little more is known of its natural history than that it is found in the interior of Asia Minor, and brought down to Smyrna for sale.

MILL-STONES.

The French Burr Mill-stone, so justly esteemed as the best material for forming mill-stones for grinding bread-corn, having the property of separating a larger proportion of flour from the bran than can be effected by stones formed from any other material.

Conway Mill-stone very much resembles the French in appearance. A quarry of this was opened near Conway, about twenty years since, which at first appeared very promising; but it was soon discovered that it was the upper stratum only that possessed

the porous property so essential, the lower stratum being found too close and compact to answer the purpose.

Cologne Mill-stone.—This substance is an exceedingly tenacious porous lava. Mill-stones are made of this material in great quantity near Cologne, and transported by the Rhine to most parts of Europe. Smaller stones, from eighteen inches to thirty, are much used for hand-mills in the West Indies, for grinding Indian corn, for which purpose they are well adapted.

POLISHING STONES.

Emery-stone.—No substance is better known, or has been subservient to the arts for a longer period, than this. The gigantic columns, statues, and obelisks of Egypt owe their carved and polished forms and surfaces to the agency of emery. It is obtained almost entirely from the island of Naxos, where it occurs in considerable abundance, in detached irregular masses. It is reduced to the state of powder by means of rolling or stamping-mills, and afterwards by sieves and levigation.

Pumice-stone is a volcanic product, and is obtained principally from the Campo Bianco, one of the Lipari Islands, which is entirely composed of this substance. It is extensively employed in various branches of the arts, and particularly in the state of powder, for polishing the various articles of cut glass; it is also extensively used in dressing leather, and in grinding and polishing the surface of metallic plates, &c.

Rotten-stone is a variety of Tripoli, almost peculiar to England, and proves a most valuable material for giving polish and lustre to a great variety of articles, as silver, the metals, glass, and even, in the hands of the lapidary, to the hardest stones. It is found in considerable quantities both in Derbyshire and South Wales.

Yellow Tripoli, *or French Tripoli*, although of a less soft and smooth nature, is better adopted to particular purposes, as that of polishing the lighter description of hard woods, such as holly, box, &c.

Touch-stone is a compact black basalt, or Lydian-stone, of a smooth and uniform nature, and is used principally by goldsmiths and jewellers as a ready means of determining the value of gold and silver by the touch, as it is termed—that is, by rubbing the article under examination upon the stone, its appearance forms some criterion; and, as a further test, a drop of acid, of known strength, is let fall upon it and its effect upon the metal denotes its value.

Blood-stone is a very hard, compact variety of hematite iron ore, which, when reduced to a suitable form, fixed into a handle, and well polished, forms the best description of burnisher for producing a high lustre on gilt coat-buttons, which is performed in the turning-lathe by the Birmingham manufacturers. The gold on china ware is burnished by its means. Burnishers are likewise formed of agate and flint; the former substance is preferred by book-binders, and the latter for gilding on wood, as picture-frames, &c.

DISTILLATION.

(Resumed from page 154.)

THE trade of the spirit distiller is divided into two branches, the malt distiller and the rectifier. The business of the first is to make from grain, or other material, an impure spirit, called malt spirit, or whiskey, with which he supplies the rectifier. This person rectifies, or purifies, that which he receives, takes from it all smoky and empyreumatic taste—renders it stronger, if necessary—and communicates to it such flavor as makes it into the various liquors called gin, peppermint, bitters, British brandy, &c. The process is as follows:—

The English malt distiller takes two quarters of barley and one of malt, which proportion varies according to circumstances, and mashes these up as a brewer does for the making of beer—no hops are added, nor is it afterwards boiled, but being cooled to about 70 degrees, set at once to work. Fermentation soon ensues—the temperature rises to nearly 100 degrees—and a spirituous liquid is formed, more and more as the fermentation proceeds. It is suffered to proceed till the liquid, or *must*, is on the point of turning sour; or, in other words, until the vinous is about to change into the acetous fermentation; and this is a nice point for the practical distiller to determine. Should he stop the fermentation too soon, the whole spirit he might have obtained is not procured; if, on the other hand, he suffers it to proceed too far, part of the alcohol already formed will be changed to vinegar, and be lost. The point to which it may go with safety being determined, the must is taken up into the still at once, when the increased heat stops the fermentation; or if he should not be ready to distil it, he lets fall into the *working tun* a few drops of grease from a candle, which immediately stops all fermentation, and he may manage his affairs at more leisure. Were there not some method of at once stopping the action going on, the whole would often be spoiled, as even an hour will sometimes suffice to ruin a large quantity. Pearl-ash is sometimes used instead of tallow grease.

The must being pumped into the still, fire is placed beneath until it boils, when the spirituous part, about one-fifth of the whole, passes over through the worm, and is caught in cans, or conveyed by a trunk into vats. That which is left in the still after the first distillation is called *distiller's wash*, and is given to pigs, cows, &c., as a nourishing article of food. The above process, easy as it seems, is yet attended with some difficulties, chiefly on account of the nature of the ingredient. This it will be evident is flocculent and loaded with glutinous matter, derived from the barley and the yeast employed—thus it will be apt to burn at the bottom of the still; to prevent this a chain lies loose at the bottom of the still, capable of being *roused* every now and then. The liquid also is loaded with carbonic acid gas, and this not only renders it very liable to boil over, but pours out of the nose of the worm in dangerous quantities, so as often to contaminate the air of the still-house to a very considerable degree, and a candle put upon the ground is very frequently extinguished by this cause.

The spirituous liquid procured by the first distillation is low in strength, and strongly disagreeable in flavor: it is called in this state *low wines*. This impure spirit is again put in the still, and distilled again along with impure potass, called in the trade grey salts. The object of these is to retain the oil which occasioned the peculiar flavor of the low wines, forming with it a kind of soap which does not pass over in distillation. The produce then of this second operation, not merely much stronger than before, but less nauseous, is now called *malt* spirit, and is in a fit state to send to the rectifier—it is sold retail under the name of whiskey, but is infinitely inferior to that of Scotland or Ireland. If distilled without the salts, it would not be so tasteless as with them still retaining the peculiar flavor of the ingredients employed, but purified from much that is sour, burnt and obnoxious to the palate. Thus, if oats be em-

..yed instead of malt and barley, and submitted to the same process, but without the salts, it produces Scotch or Irish whiskey—if raisins be fermented and distilled the result is brandy—rice produces arrack—sugar, rum—and so on; the spirit having a particular taste according to the material from which it is made.

The rectifier merely carries on the process further, and by the same means. He places the *malt spirit* into his still, adds more grey salts—makes it boil—and condenses the vapour. The spirit is now still purer than before, yet not pure enough, except for common purposes, such as the making of very common goods: it is now called *rectified spirit.* It must be distilled a fourth time, but with *white salts* —that is with pearl-ash. This time it ought to be tasteless and exceedingly strong: it is now called *spirits of wine.* If required still stronger and purer, it must be submitted to distillation a fifth time, and passing over is called *highly rectified spirits of wine*, or *alcohol*, though it is not absolutely so, as a portion of water will still be attached to it. To deprive it of this, otherwise than by the above operation, is no part of the business of the distiller.

(Continued on page 236.)

ANSWERS TO QUERIES.

37—*What is the best method of bronzing iron or steel?* Answered in page 168.

79—*Why are there not the same number of eclipses every year?* An eclipse cannot take place unless the moon is at or near one of her nodes, or the points in which her path crosses the earth's equator. This does not take place exactly the same number of times each year; that is to say, the motions of the moon do not exactly agree with the periodical revolution of the earth around the sun; and, therefore, the three bodies are not, at any particular time of the year, in exactly the same relative situation with each other, as they may be in other years, therefore the number of eclipses varies.

102—*What is the difference between sheet and forked lightning, and the cause of that difference?* When an electrical machina is in action, and no particular conducting body be held near the prime conductor, the disturbed electric fluid with which it is charged will fly off into the surrounding air in flashes of light, producing an appearance similar to a miniature sheet of summer lightning, and unattended with noise; but when the finger, or other conducting body be held near the charged machine, the fluid will be drawn off in a more concentrated and zigzag flash, accompanied by a loud snap. So it is with lightning, when the atmosphere is dry, and the evaporation great—a large quantity of free electricity is accumulated in the air; during the day it is not apparent, but in the evening, when the diminished heat causes a partial condensation of the atmospheric vapours, part of that latent electricity becomes free, and passes away to the earth, &c., in gleams of diffused light; but should an uncharged cloud pass through such a charged atmosphere, it would collect the fluid to itself, and retain it until as it wafts along it meets with another cloud, or else a part of the earth, which is differently electrified, when immediately a commotion takes place—a violent attraction between them ensues—and the lightning passes across in vivid and forked flashes.

103—*Is there any rule for geometrically trisecting any rectilineal angle?* This question has always been considered one of the geometrical impossibilites; but a correspondent writes us from Belfast, that there is a method of trisecting an arc, (which is much the same thing,) in Ward's Mathematician's Guide. We have not the work to copy it from.

107—*Why may there not be invented a perpetual motion, and what is the nearest approach to it yet known?* Answered in page 194.

108—*Why is snow white?* Color arises from a peculiar property the surfaces of bodies have in absorbing some part of the rays of light, and refracting others: thus, if a substance absorb all but the red rays, it will appear red; if all but the blue, it will seem blue; if it absorb all of them, it will be black; if none of them, that is, if it reflect all the light it receives, it will be white. Thus it is with snow; by why it is that snow and other bodies have their particular properties of absorption and reflection is, and perhaps may ever remain, unaccounted for.

110—*What is the best receipt for permanent ink, for writing on linen without preparation?* See Miscellanies of present No.

111—*How is the Koniophostic Light, as shown at the Surrey Zoological Gardens, produced?* Answered in page 188.

114—*If you place a pail of water in a fresh-painted room a film of oil will come on the surface. What is the reason of it?* The fumes of oil and turpentine which are floating about a room fresh painted are condensed, when they come in contact with the cold surface of the water, and thus not merely a film of oil is seen to cover the pail, but the room loses its smell much sooner than if the oily vapours were allowed to float about unarrested.

116—*When an effervescing draught is mixed in a tumbler, and stirred with a spoon, or glass rod—this striking the edge of the tumbler emits a different sound as the effervescence proceeds. Why is this?* Sound is occasioned at all times by the vibration of an elastic body, and as these vibrations are perfect or imperfect, so will the sound be clear and distinct, or confused and discordant. So also in proportion to the size of the body moved, and the rapidity of the vibration, the sound will be of a particular degree of tone and loudness. Apply this axiom to the case in question, and the reason of a difference of sound will be apparent. The glass is the object struck—the liquid within, by its gaseous particles striking the sides of the glass in their passage upwards, impede the regular vibration, and that in exact proportion to the degree of effervescence: thus the sound of the vibrating glass varies.

121—*How is ivory to be stained of various colors, and also how bleached when yellow by time?* Answered in page 203.

122—*If a fresh egg be pressed longitudinally between the palms of the hands it will not break while an addled egg breaks easily. Why is this?* Putrefaction tends to destroy the adhesion between the particles of the egg-shell by dissolving the albumen contained in it. Thus, although the shell of a fresh egg be hard and tough, so as to resist the pressure of the hand upon it, yet as soon as the egg becomes addled, the shell becomes rotten, and breaks with a much slighter pressure. Thus in the boxes of eggs imported from abroad, almost all those found accidentally broken by their transit are bad eggs, while the fresher they are when packed, the less will be the proportion of those broken.

MISCELLANIES.

Purifying Linseed Oil.—It is requisite that artists should hava the linseed oil they use perfectly colorless, as otberwise it would spoil the more delicate tints. To purify it is extremaly easy—even putting a bottle of the oil in the sun for some days will accomplisb the object; but as this process is somewhat tedious, it is better to put in a two-ounce phial, tbree-quarters full of good common linseed oil, a piece of whiting, as big as a nut, previously powdered. Shaka them togetber, and put the pbial on tha hob of a stove, or in an oven. In two days, and sometimes in a few bours, tba whiting will bave carried down to the bottom all calor and impurity, and tha refined oil floating at top may be poured off for use.—ED.

Inks for Morking Linen.—Dissolve one dram of the salt, called nitrate of silver, or lunar canstic, in three-quarters of an ounca of water. Add to the solution as mucb liquid ammonia as will re-dissolve the precipitated oxide, with sap green to color it, and gum water to make tbe volume amoant to one ounce. Traces written with tbis liquid should be first heated before tbe fire, to expel the excess of ammonia, and then exposed to tbe sun-beam to blacken. For this liquid, linen requires no previous preparation.—URE.

Second Receipt.—Imbue the linen first with a solution of carbonate of soda. Dry the spot, and write upon it with a solution of the nitrate of silver, thickened with gum, and tinted witb sap green.—

Composition Ornaments for Picture Frames, &c.—The commoner ornaments, wbicb are employed for the decoration of the interior of theatres, &c., are made, as bas already been mentioned, (see page 64,) of mashed papar. The more delicata scroll work, however, usually used to decorate pictura frames and looking glasses, made by dissolving some glue in water, in tbe sama manner as carpenter's use it, but not so atroug a solution as they require. Add to this wben melted a littla brown sugar, or treacle, and as mucb whiting as will maka the whole a strong paste, or ratber thin dough, wbicb wben bot sbould be just liquid enougb to be poured into tbe mould. After an bour the cast may be taken out, and suffered to dry gradually—tbe use of tbe sugar is to prevent tbe mass cracking while becoming bard. The moulds are of melted sulpbur, mixed with black lead to tougben it, and made in tbe same manner as recommended in No. 24, page 191. They must be well oiled or greased, before using.—ED.

Wax Impressions from Seols, &c.—Warm the seal a little, and rub over it the end of a wax candle—then sprinkle it with the best vermillion. Malt the sealing wax by bolding it over a candle, so that it doas not catcb fire—suffering it to drop upon the paper; impress tbe prepared seal upon it, and if done carefully, a fine impression will be made. If several seals are to be made at once, or even one of a large size, it is customary to melt tbe sealing wax in a small ladle, or crucible, from wbich it may be poured as wanted.

Sometimes seals of different colore are seen. …e are made by merely dusting the seal witb a … of one color and stamping it upon wax of …r; tbus, dust the seal with lamp black, and impress it upon red wax—the impression will bave a black centre and red edge.

Color produced by Cold.—In two or three wine glasses, each containing some distilled water, diffuse a little newly prepared *white* prussiate of iron, and exclude tbe action of tbe air, by covering tha contents of eacb glass with a thin layer of oil. If these colorless liquids be now exposed to different degrees of cold, it will be perceived, tbat, whenever tbe water in either of them freezes, the white precipitate will become blue.—SIR H. DAVY.

Color changed by Air.—Dissolve some oxyde of nickle in caustic ammonia, wbich will produce a solution of a ricb *blue* color; by exposure to tbe air, this gradually changes to a *purple*, and lastly, to a *violet;* tha addition of an acid will, bowever, convert the whole into a *green.* Add ammonia again and the original color will be restored, and pass tbrough the cbanges as before.

To Restore Decoyed Writings.—Cover the letters with phlogisticated or prussic alkoli, with the oddition of a diluted mineral acid; upon the application of whicb, the letters change very speedily to a deep blue color, of great beauty and intensity. To prevent the spreading of the color, which, by blotting the parchment, detracts greatly from the legibility, the alkali should be put on first, and the diluted acid added upon it. Tbe method found to answer best has been, to spread the alkali tbin with a feather or a bit of stick cut to a blunt point. Though the alkali should occasion no sensible cbange of color, yet the moment the acid comes upon it, every trace of a letter turns at once to a fine blne, which soon acquires its full intensity, and is beyond comparison stronger than the color of the original trace. If, then, tbe corner of a bit of blotting paper be carefully and dexterously applied near the letters, so as to imbibe the superfluous liquor, the staining of the parchment may be in a great measure avoided; for it is this superfluons liquor wbich, absorbing part of the coloring matter from tbe letters, becomes a dye to wbatever it touches. Care must be taken not to bring tha blotting paper in contact with the letters, becausa the coloring matter is soft whilst wet, and may easily be rubbed off. The acid chiefly employed is the marine; but both the vitriolic and nitrous succeed very well. They should be so far diluted as not to be in danger of corroding the parchment, after whicb the degree of strengtb does not seem to be a matter of much nicety.

Collot's Soft Varnish.—Take of virgin-wax, four ouncas, of amber, (or of the best asphsltum calcined,) and of mastic, each two ounces, of resin, common pitcb, or shoemaker's wax, each one ounce, and of varnisb, or turpentine, half an ounce. Having prepared all these ingredients, take a new earthen pot, and put it over tbe fire, witb the virgin-wax in it: and wben that is melted, add gradually to it tba pitcb; and afterwards the powders, stirring tha mixture eacb time in proportion to tba addition made to it. When tbe wbole is sufficiently melted and mixed togetber, take tbe pot from the fire, and baving poured tbe mass in an eartben vessel, full of clean water, form it into balls, by working it with the bands, and keep them in a box, free from dust, for use.

The two ounces of mastic are to be used only in summer, because it bardens the varnish, and praserves it from being cracked by tba engraver's leaning over tha plate doring the graving; but in tbat designed for winter, only ona ounce abould ba put.

Fig. 1.

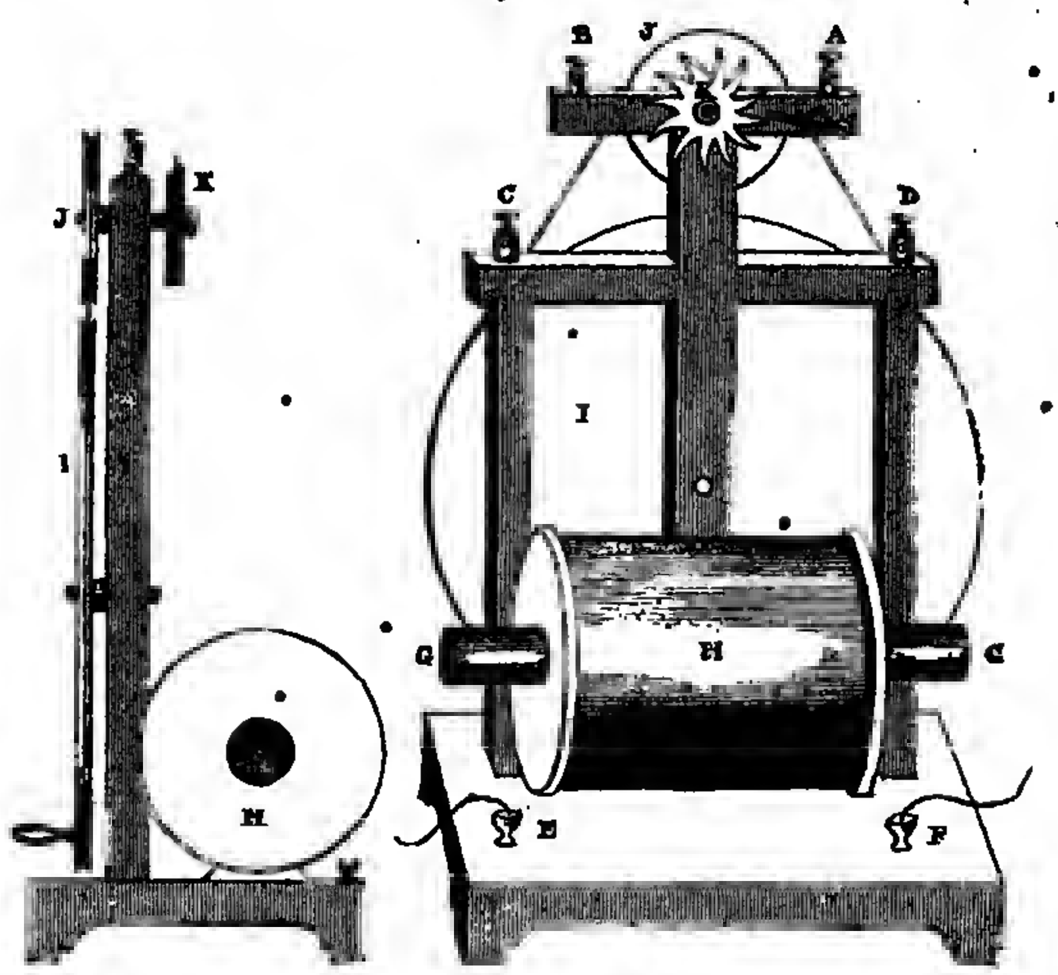
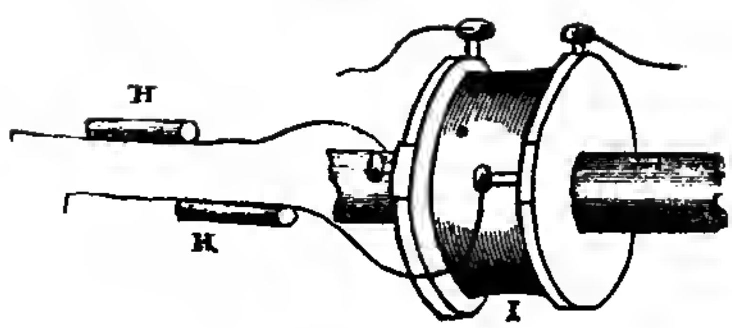


Fig. 2.



BACHHOFFNER'S ELECTRO-MAGNETIC MACHINE.

Of all the sciences which have, from time to time, occupied the attention of mankind, no one has made such rapid progress, nor has been attended with such unexpected results as galvanism; and those great discoveries which have marked its course are rendered still more wonderful, as they have, for the most part, arisen not from larger or more complicated apparatus, but from batteries and machines, infinitely less expensive and more simple than those previously employed. Of these machines, one of the most ingenious and effective is the subject of the present paper; and one of the simplest batteries is that of Mr. Mullins, commonly called the sustaining battery. These two, indeed, should be used together, as by their joint assistance, intensity, quantity, and long continuance of the galvanic power can, at all times, be insured, and at comparatively a very trifling expense.

To understand properly the Electro-magnetic Machine of Mr. Bachhoffner; it is first necessary to consider the effects of passing a current of the galvanic fluid, (if fluid it be,) through a very long conductor.

Ex. 1.—Charge a small galvanic battery, and take hold of two short wires—connected, one with the copper end of it, and the other with the zinc (the hands being previously wetted,) when a very small shock only will be perceived.

Ex. 2—Let one of the wires be forty or fifty yards long, covered with cotton or silk, and coiled up. The shock felt from the same battery will be greatly increased.

Ex. 3.—Place within the coil mentioned in the last experiment an iron rod, about an inch diameter, and the shock will be felt much stronger than before.

Ex. 4.—Instead of the iron rod, place within the coil a bundle of iron wires, six or seven inches long, and of such a number as to be of the same bulk as the rod. Upon passing the current through the coil as before, and making the body part of the circuit, the shock will be doubly as intense as before.

In the three last experiments, as well as in all those which follow, it is to be observed that the effect takes place only at the moment when contact with the battery is made and broken, and for this reason,—it is not the fluid contained, or rather disturbed, in the battery itself which passes through the coil of wire; but in galvanism, as well as in free electricity, when one body is charged it influences, and fresh arranges the fluid which those bodies in its neighbourhood are charged with. Thus when the coil is used, its whole latent fluid is disturbed at the moment of contact with the battery, and to produce a constant succession of such disturbances, an equally rapid breaking and forming again the connection of the battery and the coil are necessary. Mr. Bachhoffner's machine accomplishes this easily. In galvanism the effects produced are of two kinds; one effect arises from the quantity of fluid excited, or put in motion—the other is not according to quantity, but to intensity. For example, if two very large plates, one of copper, the other of zinc, be rolled up so as to form a battery, and the effect of it be observed, it will be found to melt the metals, and to produce a very brilliant light with charcoal points, but it will scarcely give a shock, or decompose water; but if the two sheets of metal be cut up into numerous smaller plates, and arranged so as to form a compound battery, they will now decompose water rapidly, though they would not before. To accomplish this double action at pleasure, a second coil of a thinner wire is wound round the first coil; and when a shock is passed along the first wire, a disturbance of the fluid takes place in the second, and if any body be connected with its two ends, chemical decomposition will rapidly take place. The coil is represented in Fig. 2, and may be thus made:—For the iron wires in the centre, procure some common bonnet wire, covered with cotton, straighten it, and cut it into lengths of about six inches; tie these up in a bundle about an inch in diameter—then have made by the turner a bobbin of wood, which is to be four inches long, and formed in the same manner as the reels upon which cotton is usually wound—with a hole in the centre large enough to pass the bundle of wires within it, and with upright sides, to prevent the wire which is to be wound round it from slipping off. The wire for the inner coil is common thick bell wire, (No. 16.) It must have cotton or silk twisted round it, and be about 100 yards long, (80 yards will do very well.) It is to be coiled evenly over the bobbin prepared for it, the ends being left out. Upon this primary coil as it is called, is wound, in like manner, a second of very thin wire, also covered with cotton. This may be of the size, No. 22, and should be four or five times longer than the former, or about 2000 feet. The ends must also project, but the two wires are *not* to be soldered, or otherwise connected together in any part whatever.

This is the coil which forms part of the machine of Mr. Bachhoffner, seen in Fig. 1, at H. The bundle of iron wire being marked G. Attached to the machine are six binding screws, A B C D E F. Those on the foot-board E F, are for securing the poles of the battery; C D are for securing the conductors, which give the shock. Those seen at the top of all, A B, are for effecting the calorific and electro-chemical effects. I is a multiplying wheel, connected by a catgut board to the smaller wheel at J. As this turns, the toothed wheel K turns with it, and in turning strikes by its various teeth against a spring, and thus contact is rapidly and effectually broken.

To use this apparatus, fasten the poles of a small sustaining battery into the poles E F, by which means a current of electricity is made to circulate through the primary or thick coil. Thus it passes immediately from E to the inner end of the thick wire which is fastened to E. It passes along this wire, and comes out at B, where the other end of the wire is soldered. The cap F, which holds the pole of the battery, has a wire beneath, which reaches to the toothed wheel, and by means of the spring it is connected with A, whenever the wheel and spring touch each other. It will be remarked, that there is no metallic communication between A and B, until a wire join one to the other. To C and D are fastened the two ends of the smaller wire only. The application of this machine is seen by the following experiments:—

Ex. 5.—Screw into the holes C and D two conducting wires. If the hands (being previously moistened,) be now made to grasp the latter firmly, and the wheel at the same time put in motion, a rapid succession of shocks are experienced, producing the most excruciating agony, and such as few persons can withstand, even for a few seconds.

In performing this experiment, care should be taken not to continue the action of the machine after being requested to desist, as in most cases the muscles of the party receiving the shock are so forcibly contracted, as to prevent them from loosening their hands from the conductors; the shock is, however, much modified by removing the bundle of iron wires, G G.

Ex. 6.—Screw into the hole, A, an iron wire, and into the opposite one of copper; to the other end of which a file must be securely fixed by twisting the wire round it several times: remove also the toothed wheel from its stand, then draw the end of the iron wire up and down the file, very beautiful scintillations will be thrown off, forming a very brilliant experiment if performed in a darkened room.

Ex. 7.—Remove the file from the copper wire in the last experiment, and press the latter (the connexion with the instrument remaining as in the

former experiment) firmly on a sheet of tinned iron, that has been previously scratched with any pointed instrument; strew over the latter a few grains of bruised gunpowder; by drawing the iron wire briskly over the tin plate, in contact with the powder, it will be readily inflamed.

Ex. 8.—If a tea-spoonful of ether be substituted for the powder, the latter will, in like manner, be ignited.

Ex. 9.—The decomposition of water is usually shown by a battery of very numerous plates; it being well understood that a single pair of plates is incapable of effecting it; by the aid of this instrument, the decomposition of water is readily obtained by a single pair of plates of the smallest size. Dr. Wollaston's celebrated thimble battery, or even a wire of zinc and copper, being sufficient for the purpose. In all these electro-chemical effects, the primary current is the one employed, the power of the secondary current, although capable of producing the most violent muscular action, possesses but very feeble decomposing or calorific properties.

Screw two copper wires into the holes, A B, the ends of which must be made to dip into a cup containing water; if the wheel be now revolved, the decomposition will proceed with some rapidity.

Ex. 10.—Substitute for the wires in the last experiment two small plates; place between these a piece of white blotting paper, saturated with a solution of the iodide of potassium; after the wheel has been turned for a few seconds the salt will be decomposed, showing, by the stain on the paper, the liberation of iodine. The neutral salts may be decomposed, in a similar manner: litmus paper being employed instead of the former.

The apparatus is furnished with wheels and springs of several different metals, for showing the variation in the light evolved; when these are employed, the effect is much increased by employing a more powerful battery.

Gold, silver, and copper leaf, also readily undergo combustion when treated in a similar manner, displaying the characteristic light peculiar to each.

In conclusion, we may add, that all the effects of the compound or intensity battery, may be exhibited, by the aid of this instrument, with a single pair of plates. An account of the sustaining battery in our next.

DOCTRINE OF ISOMORPHISM.

Isomorphism, derived from two Greek words signifying similarity of form, is the name given to that branch of science, the object of which is to point out the relation held by the various elementary bodies to each other, and extending from them through a lengthened series of chemical compounds. Few subjects in truth are more worthy of examination than this theory, (if theory it should be called,) for the discovery of which mankind is indebted to the chemist Mitscherlich.

Let a person examine specimens of phosphorus and arsenic: though there be few marks of similarity between them—the one being a metal, the other a substance "sui-generis;" he will be struck by the remarkable coincidence in the odour peculiar to the bodies. This, though of little moment, when viewed as an isolated fact, might invite further investigation; and, pursuing it through their combinations, the resemblance will be found still more striking; thus they both form acids, containing five proportions of oxygen; and the salts, formed by the combination of these acids with alkalies are what is called *isomorphous*—that is, they are of equal form: the arseniate of soda, for example, crystallises in oblique rhombic prisms; so also does the phosphate of the same base;* hence, when these two salts are dissolved together in water, it is a most difficult thing to crystallise them apart. If the bisulphate of any base be examined, it will be found to correspond precisely with binarseniate of the same, or any isomorphous base. By observing many such coincidences as these, Mitscherlich was led to the conclusion, that all known elementary substances were more nearly related to each other than had been hitherto imagined, and thus laid the foundation of his brilliant discovery; the doctrine of which, (a strong confirmation of the atomic theory,) is founded on the following law: that, "the same number of atoms, combined in the same way, produce the same crystalline form; independent of the chemical nature of atoms, and determined only by their number and relative position."—*Graham's Chemistry, page* 137. Isomorphism, in the strict sense of the word, can only be recognised between bodies in a crystalline form such as the salts I have alluded to; in these, however, there are several things common to both: the oxygen of the acids, the alkali, and the water of crystallization; here the phosphorous and arsenic, being the only components that cannot be paired off, are presumed to be isomorphous, though not capable of actual comparison.

The number of elementary bodies now known amounts to 55:* of these, 12 are non-metallic, the remainder, metallic. Instead of dividing these bodies into artificial groups, referring either to the date of their discovery—their electrical affinities—or the effects of oxidation upon them—it is far more philosophical to classify them with regard to their natural alliances: thus, to revert to our original illustration, though the bodies selected, belong to different orders, no chemist would think of considering arsenic apart from phosphorus: on these principles, all elementary substances have been divided into isomorphous groups, which possess properties common among themselves; and these individual groups may be further concentrated, with a few exceptions, which will be noticed, into one harmonious whole. Let us take a brief survey of the best-marked groups, and consider the relation they bear to each other: oxygen, sulphur, selenium, and tellurium, though at first sight appearing to possess little relation to each other, are placed under one head; the resemblance between the non-metallic bodies, sulphur and selenium is undoubted. This is observed not only in the form of the crystals of which they bear a component part, but in many other circumstances; thus they are found together in nature, are both fusible, volatile, and combustible, in the same degree, forming with hydrogen, colorless and combustible gases, sulphuretted and seleniuretted hydrogen. This analogy is carried through the metallic sulphurets and seleniurets; and, when combined with three atoms of oxygen, these bodies generate powerful acids; and selenic acid, like sulphuric acid, when mixed with water, raises its temperature considerably; again, the sulphate and seleniate of soda are isomorphous, and less soluble in 212° than 100°, no common coincidsnence. Tellu-

* This includes the metal "Lantane" recently discovered by Dr. Hermann Meyer, of Berlin.—Vide British Association 1839. Section B.

rium is related to the above by one of its acids exactly similar in composition and properties to sulphuric acid. Let us now inquire in what way oxygen is connected with this group? And it is to organic chemistry that we must look for a solution of this problem: the *oxide* of hydrogen is, we know, water; the *sulphuret* of the same body is the gas sulphuretted hydrogen. Here there is nothing remarkable—but let the analogy between sulphur and oxygen be further traced, and we shall find that either of these bodies may be substituted for the other. Alcohol, according to Liebig, is the oxide of an imaginary base, called ethyle, combined with an atom of water; its properties are well known—it is volatile, combustible, and when distilled yields ethers; alcohol has its isomorphous compound, called mercaptan, in which sulphur takes the place of the oxygen, for it is a sulphuret of ethyle, combined with an action sulphuretted hydrogen. It possesses in a striking manner the properties of alcohol, and yields sulphur or yarric ethers. Further evidence is not wanting to show the propriety of ranking oxygen in this group. Hydrated cyanic acid, or cyanic acid with a proportion of water, has its sister compound in hydrosulphocyanic acid, where the other elements remaining unaltered, the two atoms of oxygen are replaced by two of sulphur.

Another well-marked group is that containing chlorine, iodine, bromine, and fluorine. All these substances combine with hydrogen, forming gases, characterised by their odour and properties. The three first elements set fire to certain metals, when introduced into their vapour—they all are negative electrics, and form acids with five atoms of oxygen and the salts of which have a well-defined isomorphous character. Bromine and chlorine form a crystalline hydrate a 32°, with ten atoms of water, nitro-hydrobromic acid, like aqua regia, which is a mixture of the nitric and hydrochloric acids, possessing the power of dissolving gold. Not less interesting is the group in which we find nitrogen, antimony, arsenic, and phosphorus; little need be said concerning the two latter, as they were considered in a previous part of this paper. Arsenic and antimony are prone to form acids when they unite with alkalies; their chlorides are volatile, may be sublimed without change, and are decomposed by water. All four, when combined with five atoms of oxygen, exist as strong acids; but their analogy is most decidedly seen when combined with three atoms of hydrogen, for there is phosphuretted, arsenuretted, and antimonuiretted hydrogen while the nitrogen yields ammoniacal gas.

Another class contains potassium, sodium, ammonium, silver, and gold; the salts of which are isomorphous; among these is introduced a substance, (ammonium,) which is not an elementary body, but is an hypothetical compound radical, and the base of hydrated ammonia. I need not point out the parallelism existing between ammonia, potash, and soda; this is an instance where the oxide of a compound radical is isomorphous with the oxide of a simple metal, and is strong evidence of the existence of such a body as ammonium.

One of the largest groups is that in which are placed the elements calcium, magnesium, manganese, iron, nickel, cobalt, zinc, cadmium, copper, bismuth, and hydrogen; the assumption of a proportion of oxygen is a property, common to all these substances, in which state they are, of course, protoxides; if these protoxides be isomorphous they ought to be able to be substituted one for another; and this is found to be the case, for they are all capable of acting the part of constitutional water in salts, which water is the protoxide of hydrogen. The salt green vitriol is a sulphate of iron, with (in general) six atoms of water, but the sulphates of zinc and copper—of copper and nickel—or of manganese and magnesia, will crystallize together with the same quantity of water, and will assume the same form without containing a trace of iron. These coincidences are such as could happen to isomorphous bodies alone, and confirm the truth of the doctrine. The last-mentioned elements are prone to assume a larger proportion of oxygen; namely, three of oxygen to two of metal, when they are peroxides; and this brings us to a smaller group, which exists only in that state, or, in strictness, whose protoxides have not yet been isolated. This includes aluminum, glucinum, chromium, vanadium, and zirconium; the salts of these oxides are remarkable for their sweet taste, hence the name of one of them. Alum we know to be a double sulphate of alumina and potass, but crystals of the form of alum may be obtained from the sulphates of potass, and peroxide of iron, because the latter is isormorphous with alumina. Chromium and vanadium form acids with three atoms of oxygen, both which are converted into the oxide by contact with organic substances.

Barium, strontium, and lead, form a small group closely allied to the magnesian. They have protoxides, which are slightly soluble in pure water; the sulphates of barytes and lead are insoluble, and not only isomorphous, but *dimorphous*—in reference to which a few words are required. Dimorphism, as the term implies, is the property of those substances which possess double isomorphism; and by its aid we are enabled to ally the above groups very closely to one another; its application will be seen in some of the following examples; the chlorine group, for instance, cannot be united directly with that containing sulphur, but it can indirectly through manganese; in this way—chlorine forms an acid with seven atoms of oxygen, so also does manganese, and thus hyperchloric and hypermanganic acids constitute a connecting link between the groups they respectively represent; in the same manner maganates are isomorphous with sulphates, consequently manganese with sulphur, and the latter, through the former, with chlorine. The transition from the manganese to the aluminous group is all but imperceptible, as they both agree in the constitution of their peroxides, and as before mentioned chromium and vanadium form acids which are isomorphous with the manganic and sulphuric. If it were not for dimorphism, we should find it difficult to connect that group which contains lead with any of the others, for through agreeing in constitution with the magnesian, the general form of its crystals do not harmonize; carbonate of lead is usually crystallized in right rhombic prisms, whereas carbonate of lime as calcareous spa assumes the rhombohedron, these crystals would be incompatible with isomorphism, were it not known that the substance are dimorphous; lead in plumbo-calcite being analogous to calcareous spa; and lime in arragonite occuring in right rhombic prisms—the most common form of carbonate of lead. It must be confessed, that, in the present state of our knowledge, it is almost impossible to connect the potassium or phosphorus

groups with those which have preceded, yet the evidence in favor of the doctrine is too convincing to be easily upset. To those even who refer all points to the standard of utility, an investigation of this subject will prove satisfactory, for even if there be no truth in it, it affords us a simple classification, and shows how nature in all her works proceeds by gradations rather than sudden changes. Another benefit is that the affinities of the elements may be soon acquired, if considered with reference to this classification, for the student who is acquainted with chlorine or iron has already gained an insight into the other elements belonging to their respective groups. Space permits not further detail; those who feel interested in the doctrine are referred to "Graham's Elements of Chemistry," the only work in the language in which it is satisfactorily and philosophically discussed.

W. J. PRESTON.

CASTING MEDALLIONS, &c., IN PLASTER OF PARIS.

(Resumed from page 192.)

The moulds being prepared, as described in the former paper, it is now requisite to consider how to produce a medallion similar to that from which it was cast, and this is to be done in plaster of Paris—the choice of which for the purpose requires attention. That plaster which is usually employed by the plasterers, and sold at the various oil-shops, is only adapted for the coarsest work, such as the various parts forming moulds of large figures, busts, pieces of statuary, &c., and even in these a thin inner coat of finer plaster is necessary. That kind used for the making of medallions, plaster figures, and architectural models, is called superfine plaster, and can be bought only at the manufacturers, or at the Italian figure makers. (Of the latter class two live in Drury Lane—one in Russel Street, one in Frith Street, Soho—and several in Liquorpond Street; who sell it in bags, or half bags, at about 1*s*. each.)

The moulds are to be prepared as follows:—Take a small piece of wadding, make it damp with clean sweet oil, and rub it over the face of the sulphur mould, making this wet with oil, but not so wet as that the oil shall lay upon it in drops, or fill up the cavities—a uniform thin surface of oil being all that is requisite. When you have oiled a number of the moulds in this way, (say twenty of them,) surround each with a strip of hard paper, and fasten the end of it with paste or a wafer. The moulds will now be ready for use.

Next, pour some water in a basin to about three parts full, and *sprinkle* into it as much of the plaster as you think will suffice for the moulds which have been prepared, to cover each a quarter of an inch in thickness. When the plaster is sprinkled in, pour off all the water which floats above it, and with a spoon, (not iron,) stir up the plaster, which will now be found about as thick as honey, and put about a tea spoonful into each of the moulds; and as quickly as possible afterwards brush it with a small stiff-haired brush into all the depressions of the mould. This is best done by holding the brush upright, and slightly beating the plaster with the points of the hairs. Then immediately afterwards, and before the plaster begins to set, or to get hard, fill up each mould to the requisite thickness, and as each is filled up take it in the left hand, (supposing the spoon to be in the right,) and tap the bottom of it gently upon the table four or five times, merely to shake the plaster down evenly, so as to present a level surface at the top, and to prevent holes appearing upon the face. The cast is now completed, and will in a few minutes become sufficiently hardened to be removed from the mould, when it will only require trimming with a knife around the edges, and gradually drying. Oiling the moulds each time, any number of casts may be made in the same manner.

The time which plaster of Paris takes to set varies extremely—when very fresh it will be, perhaps, five minutes—when rather more stale, it will often set so rapidly, that it is extremely difficult to use it quick enough. When still longer kept it will gradually lose its power of setting altogether; and not only so, but become rotten and wholly unfit for the purposes of the caster. Some of the above inconveniences may be remedied as follows: If it set too quick for the object in view, put a very small quantity of size, or thin glue, in the water used, (a large spoonful of melted size is enough for a pint of water.) If you desire it to set rapidly, use warm water instead of cold. This is necessary when a cast of the face is to be taken—if you desire it to be very hard, and yet set quickly, mix it up with strong alum water. Plaster when once it has begun to set, should never be disturbed, and never can be mixed up a second time, therefore, the basin, spoon, and brush, must always be carefully washed between each casting. The casts made can only be imperfect in one way: that is, in having air bubbles on their surface. These arise either from the plaster when poured on being too thin, or else not well shaken down—a very little attention, therefore, will remedy the defects at a subsequent casting.

Plaster medallions are often seen colored, even sometimes gilt, and still more frequently polished. These processess are all simple. The painting of them is of two kinds; in one the figures and prominences are left white, and the flat ground is colored either with *emerald green*, smalt blue, or lamp black, made glossy by the addition of gum water, and laid on with a common camel's-hair pencil. In the other case of painting all the objects are colored with common water colors, according to their natural appearances. In this painting all the caution necessary to be observed is to use no color that can be decomposed by the plaster of Paris, which is the sulphate of lime. Thus in making a green for trees, grass, &c., employ indigo and not Prussian blue, for in a few days, by the partial decomposition of the latter color, the greens become yellow. Plaster casts may be gilt by rubbing them over with the white of egg, and immediately putting upon them some gold leaf, which will adhere firmly. They are polished or made glossy on the surface, thus—Take some white curd soap, and dissolve it in water, so as to make a strong solution. Pour a little of this in a saucer and immerse the face of the medallion three or four times, letting it dry for a minute or two between each immersion. Put it aside till the next day, and then gently rub the surface with a small piece of wadding, or loose cotton, when a very smooth, beautiful, and glossy surface, will appear upon it. They will now be much less liable to attract dust; moulds may be made from them as before, and if dirty may even be slightly washed without injury, polishing them again only when they are perfectly dry. In this manner the

Italians have lately polished the surface of many figures they are accustomed to make, particularly the phrenological heads sold in the shops. The reason of this effect must be evident to the chemist. The soap is decomposed by the plaster, the alkali of the soap is taken up by the sulphuric acid of the plaster, and the other constituent of the soap, namely, grease, is set at liberty, and remains as a glossy coat upon the surface. If it be desired to bronze a plaster figure, or medallion, paint it over with a mixture of Indian ink, indigo, and gamboge, or, still better, Indian yellow; so as to be of a dark and uniform olive color. Touch the more prominent parts with bronze powder, and varnish the whole over carefully, so as not to disturb the powder, with a weak solution of dragon's blood, dissolved io spirits of wine, and if well done they will appear as fine as any of the bronze medals of antiquity, though not so clear in their details; nor, (owing to their coat of color,) so sharp as medallions made of sulphur, afterwards to be described.

If plaster is at any time to be cast out of a plaster mould, the latter must be well greased before using, or if the moulds have been previously boiled in wax and grease, as recommended by some persons, or washed over with this mixture in a boiling state, oiling will alone be necessary. A very thick solution of soap will answer to separate the two surfaces. This is used by modellers.

(Continued on page 239.)

RAILWAYS.

(Resumed from page 198, and concluded.)

Curvatures in the Road.—The curvatures of the railroad present some obstructions, since the axles of the car and waggons being usually fixed firmly to the frames, every bend of the tracks must evideotly cause some lateral rubbing, or pressure of the wheels upon the rails, which will occasion ao increased friction. If the wheels are fixed to the axles, so that both must revolve together, according to the mode of construction hitherto most usually adopted, in passing a curve, the wheel that moves on the outside or longest rail must be slided over whatever distance it exceeds the length of the other rail, in case both wheels roll on rims of the same diameter. This is an obstruction presented by almost every railroad, since it is rarely practicable to make such a road straight. The curvatures of some roads are of a radius of only 300 and even 250 feet. The consequence was that the carriages heretofore in usa were obstructed, not only by the rubbing of tha surfaces of the wheels upon the rails, already mentioned, but also by the friction of the flange of tha wheel against the side of the rail. This difficulty has, however, been in a great measure remedied by an improvement made in the form of the rim of the wheel. The part on which this rim ordinarily rolls on the rail, is made cylindrical, this being the form of bearing evidently the least injurious to the road, as the weight resting perpendicularly upon the rails has no tendency to displace them or their supports. But between this ordinary bearing and the flange, a distance of about one inch in a wheel of thirty inches in diameter the rim was made conical, rising towards the flange one sixth of an inch, and thus gradually increasing in diameter. Wherever the road bends, the wheel, rolling on the exterior, and, in such case longer track, will, in consequence of the tendency of the carriage to mova in a right line, be carried up a little on tho rail, so as to bear upon the conical part of the rim, which gives a bearing circumference of the wheel on that side greater than that of the wheel on tha opposite end of the same axle. The tendency, accordingly, is to keep the car io the centre of the tracks, by producing a curvilinear motion in the waggoo, exactly corresponding to the curve of the road. In the raport made by Mr. Knight (of the United States of America), in 1830, he says that a car, with wheels such as those already described, was run upon a part of the Baltimora and Ohio railroad, where the greatest curvatures were of a radius of 400 feet, at the rate of fifteen miles per hour. In his report of October 1, 1831, Mr. Knight says that the additional friction on such a curve, above that on a straight road, is 1 in 1418, equal to 3.72 feet in a mile, with Winah's car, and in 1 356 equal to 14.83 feet in a mile, with another car. If the diameter of the wheel is increased, that of the conical part of the rim should be increased also, making the rise of the conical part between the flange and the cylindrical part (as Mr. Knight estimates in his report of February, 1830), one fifth of an inch in a wheel of three feet diameter, and one fourth of an inch in a wheel of four feet diameter. In his report of October 1, 1831, he says he had changed the ratio of the conical part of the rim, on wheels of the same size, from that of one to six, to that of one to five, and had increased the length of the conical part to 1 3-16ths of an inch: and that he thinks the form of the rim was thereby improved. In the same report, Mr. Knight describes a method of turning a very short curve of a quadrant of a circle on a radius of sixty feet, by making a plate with a groove for the flange of the wheel on the longer track to run in; thus, in this case, making the difference of the rolling circumference of the wheels correspond to that of tha two tracks. This plan was adopted for the purpose of turning corners or streets in towns, and, from experiments that have been made, promises to be successful.

Inclined Planes.—Where the inclination of the road is greater than that for which the ordinary power is calculated, the ascent must be effected by means of an additional power, the amount of which can be readily computed, since, in these parts, no additional friction of the cars or wheels is to be provided for, and only the additional resistance arising from gravity is to be overcome. If, for instance, the additional inclination is one in ninety-six, or fifty-five feet in a mile, the additional power must be to the weight as one to ninety-six, or as fifty-five to the number of feet in a mile, namely, 5280. In descending planes, so much inclined that the gravity would move the carriages too rapidly for safety, the velocity is checked by means of a break, which consists of a piece of wood of the samo curvature as the rim of a set of the wheels, upon which the break is pressed by means of a lever, so adjusted as to be within reach of the conductor, in his position on the carriage.

Power.—Gravity, horse power, and steam power have been used on railroads. Where the road is sufficieotly and uniformly descending in one direction, gravity may be relied upon as a motive power in that direction; but on railroads generally, some other power must be resorted to in each direction. At the time of the construction of tha Livepool and Manchester railway, much discussion took place, as to the expediency of using stationary or locomotive steam-engines. The result of the deliberations was, that if locomotives could be con-

structed within certain conditions as to weight and speed, they would be preferable. The director accordingly offered a premium for the construction of such a locomotive, as should perform according to the conditions prescribed. At the celebrated trial on that road in October, 1829, of which Mr. Wood gives a particular account in the edition of 1831 of his work on railroads, the locomotive, called the Rocket, constructed upon the plan of Mr. Robert Stevenson, was found to come within the proposed conditions, and accordingly the decision, in respect to that road, was in favor of locomotives. The opinion in favor of this kind of power of road, of which the inclination does not exceed about thirty feet in a mile, has become pretty fully established. Stationary power can be used to advantage only on lines of very great transportation, as the expense is necessarily very great, and almost the same, whether the transportation be greater or less. Another objection to the use of stationary power is, that its interruption, in any part, breaks up the line for the time, which is not necessarily the case with a locomotive. The alternative, accordingly, is between the use of locomotive steam engines or horses, and the choice must be determined by the particular circumstances of the line of transportation. The advantages of this species of road are illustrated by the action of a horse upon it, compared with his performance upon the best turnpike, being as Mr. Wood assumes in one of his estimates, in the proportion of 7.5 to 1; thus enabling us to dispense with thirteen out of fifteen horses required for transportation on the best common roads. The horse's power of draught is much the greatest at a low rate of speed, since the more rapid the velocity the greater proportion of his muscular exertion is required to transport his own weight. But it is ascertained, on the Baltimore and Ohio railroad that a speed of ten miles an hour may be kept up by horses travelling stages of six miles each, which would perform the whole distance between Baltimore and the Ohio river in thirty-six hours. The whole expense of transportation by horse power, including cars, drivers, and every expense except repairs of the road, on the same railroad, from January to September, 1831, amounted to about one third of the gross tolls received; and this expense, it was calculated, might be very materially reduced. The average consumption of coke by a locomotive engine, on a passage from Liverpool to Manchester, thirty-two miles is stated by Mr. Wood to be 800 pounds, and the water evaporated 225 gallons per hour and 450 gallons on the passage. Mr. Wood computes that one of those locomotives will perform the work of 240 horses travelling at the rate of ten miles per hour upon a turnpike road, the velocity of the locomotive being fifteen miles per hour. The fact is well established, that where the transportation is sufficient for supplying adequate loads for locomotive engines, and where the road is so constructed that they can be advantageously used, and where fuel is not exceedingly expensive, they afford much the most economical motive power.

HELIOGRAPHY.

It is remarkable, that producing images by means of light, and which has lately attracted so large a share of public attention, under the various names of Photography—Photogenic Drawing—the Daguerrotype, &c., should have been discovered by three different persons at the same time,* and that their methods should be totally distinct from each other—that of Mr. Fox Talbot, described so fully in our earlier numbers—that of M. Daguerre, explained in No. XXII—and that of M. J. N. Neipce, the account of whose process is as follows, given in Mr. Neipce's own words:—

The discovery which I have made, and to which I give the name of Heliography, consists in reproducing *spontaneously* by the action of light, with the gradation of tints from black to white, the images received by the *camera obscura*.

Fundamental Principle of the Discovery.—Light, in its state of composition and decomposition, acts chemically upon bodies. It is absorbed, it combines with them, and communicates to them new properties. Thus it augments the natural consistency of some of these bodies: it solidifies them even, and renders them more or less insoluble according to the duration or intensity of its action.

Such, in a few words, is the principle of the discovery.

Primary Material. Preparation.—The substance or primary I employ—that which has succeeded best with me, and which concurs most immediately to produce the effect is *asphaltum* or bitumen of Judea, prepared in the following manner:—

I fill a wine-glass about half with this pulverised bitumen. I pour upon it drop by drop the essential oil of lavender till the bitumen can absorb no more, and till it be completely saturated. I afterwards add as much more of the essential oil as causes the whole to stand about three lines above the mixture, which is then covered and submitted to a gentle heat until the whole essential oil be saturated with the coloring matter of the bitumen. If this varnish should not yet possess the requisite consistency, it is to be allowed to evaporate atmospherically in a dish, care being taken to protect it from moisture, by which it is injured, and finally decomposed. If in winter, or during rainy weather, the precaution is doubly necessary.

A small quantity of this varnish applied cold, with a light roll of very soft skin, to a highly polished tablet of plated silver, will impart to it a fine vermillion color, and will cover it with a very thin and equal coating; the plate is afterwards to be placed on heated iron, which is wrapped round with several folds of paper, whence by this means all the moisture has been previously expelled. When the varnish has ceased to simmer, the plate is withdrawn, and left to cool and dry in a gentle temperature, secured against contact with a damp atmosphere. I ought not to omit mentioning that it is principally in applying the varnish that this last precaution is indispensable. In this part of the operation, a light circle of metal, with a handle in the centre, should be held before the mouth in order to condense the moisture of the respiration.

The plate thus prepared may be immediately submitted in the focus of the camera to the impressions of the luminous fluid. But even, after having been thus exposed, a length of time sufficient for receiving the impressions of external objects, nothing is externally apparent to show that these impressions exist. The forms of the future picture remain still invisible. The next operation then is to disengage the shrouded imagery, and this is accomplished by a solvent.

Of the Solvent and Manner of its Preparation.—As the solvent must be adapted to the purposes for which it is designed, the task is difficult to fix with

in all cases it is hetter that it be too weak than too strong. That which I employ in preference, is composed of one part, not by weight bnt volume of essential oil of lavender poured upon ten parts by measure also, of oil of white petroleum. The mixture which is first of a milky consistency becomes perfectly clear in two or three days. This compound will act several times in succession. It loses its dissolving power only when it approaches the point of saturation; this state is readily distinguished hy an opaque appearance and dark brown color.

The plate or tablet varnished as described, and exposed as directed, having been withdrawn from the camera, a vessel of tinned iron somewhat larger than it, and about an inch deep, is previously prepared and filled with the solvent to a depth sufficient to cover the plate. Into this liquid the tablet is plunged, and the operator, observing it by reflected light, begins to perceive the images of the objects to which it had been exposed, gradually unfolding their forms, though still veiled by the supernatant fluid continually becoming darker from saturation with varnish. The plate is then lifted out and held in a vertical position till as much as possible of the solvent has been allowed to drop away. When the dropping has ceased, we proceed to the last and not least important operation.

Washing. Manner of Procedure.—A very simple apparatus answers for this operation, namely, a board about four feet long, and somewhat broader than the tablet. Along each side of this hoard runs a ledge or border projecting two inches above its surface. It is fixed to a support by hinges at its upper extremity, in such a manner as permits its angle of inclination to be varied at pleasure, that the water thrown upon it may run off with the requisite velocity. The lower end rests upon the vessel intended to receive tha water as it flows down.

The tablet is carefully placed npon the board thus inclined, and is prevented from slipping down by two little blocks, which onght not to exceed the thickness of plate, that there may be no ripple in the descending stream. Tepid water should be used in a cold day. The water must by no means be poured directly npon the plate, hut above it on the hoard, so that descending in a stream it may clear away all the remaining solvent that may yet adhere to the varnish.

Now, at length, the picture is completely disengaged, and if the different operations have been carefully performed, the outlines will he found to possess great neatness, especially if the images have been received in a camera with achromatic lenses.

When the plate is removed to be dried, which must be done with great care, by a gentle evaporation, it must be kept protected from humidity, and covered up from the action of light.

Of all substances hitherto tried, silver plate upon copper appears to me to be the best adapted for reproducing images, by reason of its whiteness and structure. One thing is certain, that after the washing, provided the impression has been well dried, the result obtained is already satisfactory. It were, however, to he desired that, by blackening the plata, we conld obtain all tha gradations of tones from black to white. I have, therefore, turned my attention to this subject, and employed at first *liquid sulphate of potassa*. But, when concentrated, it attacks the varnish; and if redneed with water, it only reddens the metal. This twofold defect obliged me to give it up. The substance which I now employ is iodine, which possesses the property of evaporating at the temperature of the atmosphere. In order to blacken tha plate by this process, we have only to place it upright against one of the sides of a hox, open above, and place some grains of iodine in a little groove cut in the bottom, in the direction of the opposite side. The hox is then covered with a glass, to judge of the slow hut certain effect. The varnish may then be removed by spirit of wine.

Recapitulation.—It has been remarked above, all resins, and all residue of essential oils are decomposable by light in a very sensible degree: to produce this effect it is only required to spread them in very thin coatings over a proper surface, and to find a solvent which suits them. We may employ as dissolvents oil of petroleum, all the essential oils, alcohol, the ethers, and caloric.

M. Niepce plunged the tablet, covered with a varnish of hitumen, into a liquid solvent. But such a mode of applying the solvent is rarely in harmony with the diminished intensity of the light in photographic sketches obtained by the camera.

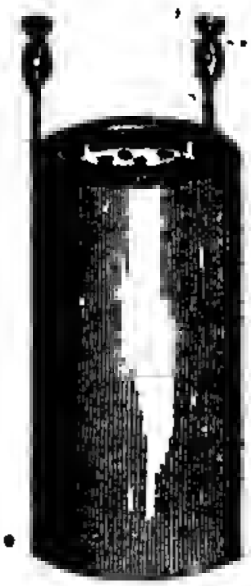
It ever happens that the dissolvent is too strong or too weak. In the former case the design is destroyed by the entire removal of the varnish; in the latter, the images are not sufficiently hrought out, and the design remains indistinct.

The effect of a solvent into which a photographic design is immersed, produces the removal of the varnish in those points where the solar action has been weak, or indeed according to the nature of the solvent, a contrary effect follows, that is to say, the points strongly acted upon hy the solar rays, namely the lights of the picture, are eroded, while the shadows remain untouched. This takes place for instance when alcohol is used instead of an essential oil as a dissolvent.

Solvents by evaporation or by the effects of caloric are much preferable. This action can always he arrested at pleasure. But in this case it is indispensable that the ground or coating do not act as varnish, it must be tough and as white as possible. The vapour of the solvent merely penetrates the coating and destroys its texture, in proportion to the greater or less intensity of the light hy which the design was impressed. This manner of operating gives a gradation of tone altogether impossible to be attained by immersing the design in any solvent.

Lunar Climate.—The moon has no clouds nor any other indications of an atmosphere. Hence its climate must be very extraordinary; the alteration being that of unmitigated and burning sunshine fiercer than an equatorial noon, continued for a whole fortnight, and the keenest severity of frost, far exceeding that of our polar winters, for an equal time. Such a disposition of things must produce a constant transfer of whatever moisture may exist on its surface, from the point heneath the sun to that opposite, by distillation *in vacuo* after the manner of the little instrument called a *cryophorus*. The consequence must be absolnte aridity below tha vertical sun, constant accretion of hoar frost in the opposite region, and, perhaps, a narrower zone of running water at the borders of the enlightened hemisphere. It is possible, then, that evaporation on the one hand, and condensation on the other, may to a certain extent preserve an equilibrium of temperature, and mitigate the extreme severity of both climates.—*Herschel.*

Fig. 1. *Fig.* 2 *Fig.* 3.



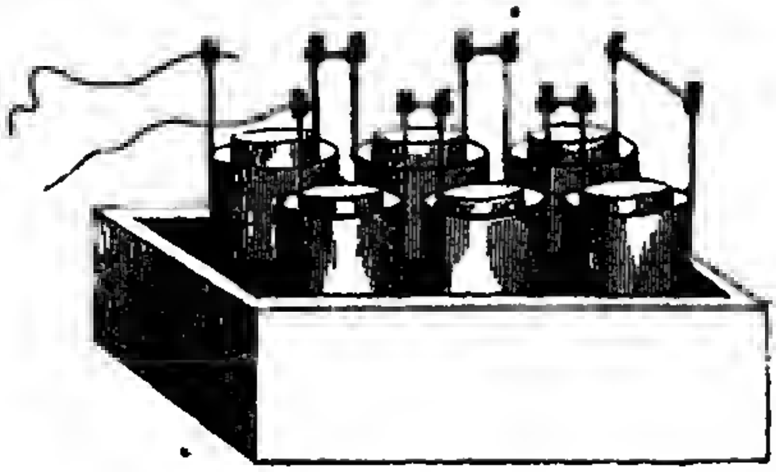


Fig. 4.

ELECTRO-MAGNETIC SUSTAINING BATTERIES.

Mr. Sturgeon was the first to form and apply the pot battery to the purposes of electro-magnetism; and that many years since, after having observed, that, in this science, the electric power might be diminished almost at pleasure, provided the magnetic power be increased in proportion to the diminution of the other element. Instead, therefore, of using the immense and expensive batteries of former times, he found that one, holding a pint, or at most a quart of liquid, was amply sufficient to occasion the usual magnetic deflections, rotations, &c. His battery is represented in Fig. 1. It consists of two copper cylinders, one placed within the other, and with a bottom connecting the two. The outer cylinder is about three inches diameter and eight inches high, and has soldered on the outside to it a wire, bearing a wooden cup to hold mercury. The other part of the battery is a cylinder of zinc, of equal length to the coppers, and a diameter between each; it also has a wire and wooden cup soldered to it. To prevent the zinc and copper touching each other when in use, three strips of wood may be fastened to it previously, or a wooden ring put on at the bottom of the zinc cylinder. To use this simple battery, fill it with a mixture of nitric acid and water, about one part of the former to twelve or fourteen of the latter—and by uniting the two cups a current of the fluid will circulate, which will be of considerable intensity; but from the violent chemical action which takes place, and

the rapid deposition of oxyde, it will be of short duration: this, though a valuable instrument for the lecture table, yet is comparatively useless to show the chemical decompositions which depend upon long-continued galvanic action. The constant battery of Mr. Daniell remedies this defect, as it remains in action with scarcely diminished intensity for some days. It consists, (see Fig. 2,) of a copper vessel, three inches and a half in diameter, and varying in height, from sixteen to twenty inches, according to the power which it is wished to obtain; withinside this, at the distance of three quarters of an inch or so, is a second cylinder, made of zinc, and without a bottom—each of these is furnished with a mercury cup, or what is more convenient, a small screw, which fixes the conducting wires in holes prepared for them: so far there is nothing peculiar; but Mr. Daniell, considering the cause of the decline of action being the various chemical decompositions going on, interposed between the copper and zinc, a membrane, formed of ox gullet, drawing it like a bag over the zinc cylinder; and also a rim, or shelf of copper, is placed withinside the copper vessel, perforated with holes. This is the whole construction of this simple instrument. To use it, the outer cell is filled with a saturated solution of sulphate of copper, (blue stone,) and portions of the solid salt are placed upon the circular plate, or shelf, for the purpose of keeping the solution always in a state of saturation. The internal tube is filled with a very weak solution of sulphuric acid and water, or it may be salt and water. A very great improvement upon this battery is to substitute for the ox gullet, a porous porcelain tube, and instead of the cylinder of zinc, a thick rod of that metal covered carefully with mercury, and merely supported at the top by a cross bar, as in Fig. 3. The mixture for this is, eight measures of water to one of oil of vitriol, which has been saturated with sulphate of copper for the outer compartment—placing crystals on the shelf as before, and the same mixture of acid and water, but without the copper for the inner space.

A number of such cells may be connected, the zinc side of one, and the copper side of the next, as shown in Fig. 4; thus making a complete and very powerful battery. Six of these, holding a pint each, may be used effectually with Mr. Bachhoffner's machine, described in the last number.

In this instrument the sulphate of zinc, formed by the solution of the zinc rod, is retained in the membranous bag, or the porous case, and prevented from diffusing itself to the copper surface; while the hydrogen, instead of being evolved as gas on the surface, of the latter metal decomposes the oxyde of copper of the salt there, and occasions a deposition of metallic copper on the copper-plate. Such a circle will not vary in its action for hours together, which makes it invaluable in the investigation of voltaic laws. It owes its superiority principally to these circumstances:—to the amalgamation of the zinc, which prevents the waste of that metal by solution when the circuit is not completed; to the non-occurrence of the precipitation of zinc upon the copper surface; and to the complete absorption of the hydrogen at the copper surface—the addition of globules of gas to the metallic plates greatly diminishing, and introducing much irregularity into the action of a circle.

MANUFACTURE OF PENS.

Quills appear to have been employed, at least, as early as the seventh century. England is supplied with this article from Russia and Poland, where immense flocks of geese are fed for the sake of their quills. The quantity exported from St. Petersburgh, varies from six to twenty-seven millions. Twenty millions were last year imported into England from these countries. We may form some idea of the number of geese which must be required to afford the supply, when we consider, that each wing produces about five good quills, and that, by proper management, a goose may afford twenty quills during the year. Hence, it is obvious, that the geese of Great Britain and Ireland could afford but a very limited supply. The feathers of the geese of the latter countries are employed for making beds.

The preparation of quills, or *touching*, as it is called, is a curious and nice process. The Dutch possessed the complete monopoly of the quill manufacture until about 70 years ago, when the process was introduced into this country, and now our quills are infinitely superior to those of Holland.

The quills are first moistened, not by immersion, but by dipping their extremities into water, and allowing the remaining parts to absorb moisture by capillary attraction. They are then heated in the fire or in a charcoal chaffer, and are passed quickly under an instrument with a fine edge which flattens them, in such a manner as to render them apparently useless. They are then scraped, and again exposed to heat, when they are restored to their orignal form. This is a remarkable fact, and deserves to be attended to. It may be illustrated by taking a feather and crushing it with the hand, so as to destroy it to all appearances. If we now expose it to the action of steam or a similar temperature, it will speedily assume its pristine condition. Many of the quills, after this preparation, are cut into pens by means of the pen-cutter's knife, and are also trimmed. A pen cutter will cut in a day, two-thirds of a long thousand, which consists of 1,200, according to the stationers' computation. A house in Shoe-lane cuts generally about six millions of pens, and last year, notwithstanding the introduction of steel pens, it cut more then it had done in any previous years. According to the calculation of pen-makers, not more than one pen in ten is ever mended.

About thirty-one years ago, Mr. Bramah introduced portable pens into this country from New York, and took out a patent for their manufacture. The process for making portable pens is to form a vertical section of the barrel of the quill and polish the pieces. The pens are then cut with a beautiful instrument, each quill affording six pens. When they have been nipped coarsely, a polish is given with the pen-knife. Sixty thousand of these pens are manufactured weekly by two houses. An attempt was made to apply steel tips to portable quill pens, but the success which was anticipated did not follow.

Metallic pens appear to have been first introduced as rewards for merit, but steel pens for writing were first made by Mr. Wise, in 1803, and were fashioned like goose pens.

A patent was taken out in 1812 for pens with flat cheeks, and in this way all metallic pens were made for some time, as the rhodium pen of Dr. Wollaston, and the iridium pen of others. About fifteen years ago, Mr. Perry began to make pens, and about nine years ago they began to be manufactured at Birmingham. The steel is pressed

into thin sheets by a rolling press. It is then cut into slips, annealed for fourteen hours, and again passed under the roller. By means of a peculiar cutting machine the pens are formed in a falchion shape. But one half of the steel is thus wasted, and no use has been found for it. It is so thin that it cannot be welded, and it cannot be melted because it catches fire and burns, in consequence of the air getting access between its thin leaves. The fibres of the steel run in one direction, and the pens are cut in accordance with this disposition. The pens are then annealed. The preparation for forming the slit then takes place. An extremely fine-edged chisel is brought down upon each separately, and is allowed to penetrate two-thirds through its substance. The edge of this instrument is finer than any razor, but is much harder, as it does not require to receive an edge during the whole of the day. This superior quality is given to the steel by beating it for several hours with a hammer. It is an important fact, and appears to have been discovered by the pen manufacturers. A triangular piece is next cut out at the upper end of the slit in the pen, which is called *piercing*. The next object is to give them their proper shape, which is effected by means of a punch fitting into a corresponding concavity.

The pens are then heated red hot and dipped into oil, which must be at least three feet deep. The oil in a few weeks loses its properties and becomes charred. The next operation is polishing. This is effected in a peculiar apparatus, called, emphatically, the *devil*, consisting of a fly wheel and box, in which the pens are placed, and to which a motion is given, resembling that required in shaking together materials in a bag. This motion is continued for eight hours, when the pens are found to be completely deprived, by the friction against each other, of any asperities which might have existed on their edges, and though not visible to the naked eye, would have obstructed the free motion of the pen in writing. After this they are tempered in a box, shaken and brought to a blue color, being carefully watched, and the heat lessened whenever a shade of yellow is observed on their surface. The slit is now completed by touching its side with a pair of pincers.

With regard to the number of steel pens made, from information communicated to Dr. Faraday, it appears that Mr. Perry manufactures one hundred thousand weekly, or five million two hundred thousand per annum. Mr. Gillot employs 300 pair of hands, and consumes 40 tons of steel annually. Now, one ton of steel produces about two millions of pens. Hence, this manufacturer alone makes eighty millions of pens annually. The total quantity of steel employed in this country for making pens amounts to 120 tons, which is equivalent to about two hundred millions of pens.

Notwithstanding the immense product of the manufacture, it is remarkable that the consumption of quills has not diminished: this may be accounted for by the consideration that within the last ten or fifteen years, the population has increased one-third, and three people now can write for one at the commencement of that period; and besides, both the Continent and America are supplied by us. When first introduced, steel pens were as high as 8*s*. per gross, they then fell to 4*s*., and recently have been manufactured at Birmingham at as low a price as 4*d*. the gross. It appears that the only interest that has suffered by the employment of steel pens is that of the pen-knife makers. Pens have also been made of horn and tortoiseshell, and it is no small consolation to consider that if steel should fail us we can have recourse to such abundant materials.

MIGRATION OF SWALLOWS.

TOWARDS the end of September, the chimney, or common swallows, disappear. There have been various conjectures concerning the manner in which these birds, and some of their kindred species, dispose of themselves during the winter. The swift is the only one of this genus, about which their appears to be little or no controversy—its early retreat and strength of wing rendering its migration almost certain; but with regard to the rest, namely, the swallow, the martin, and sand martin, there are three current opinions, each of which deserves consideration. The first, which is principally adopted by the Swedish and other northern naturalists, is, that these birds pass the cold months *in a torpid state under water*. This apparently-improbable supposition is supported by the following arguments. The places in which the species in question are seen, the latest and earliest in the year, are the banks of large deep ponds and rivers.* About the time of their disappearing they are observed to roost in vast numbers on branches of trees that overhang the water, which by their weight are observed to be bent, so as nearly to touch the surface. Some obscure reports of swallows having been dragged up in a torpid state from the bottoms of lakes have been eagerly embraced by the favorers of this hypothesis, and the proof is thus supposed to be complete. Against this opinion there are the following obvious arguments. The swallow tribe live wholly on insect food, and it is in the neighbourhood of waters that gnats and other winged insects principally abound; when, therefore, food is scarce, it is not to be wondered at that these birds should resort to those places. where it is almost always to be found in a greater or less quantity. Young swallows in autumn are universally observed to roost on trees, and to be extremely fond of congregating; when, therefore, they have fatigued themselves by hawking all day about the nest, it is highly probable that they should collect in large numbers on the nearest trees: and, besides those branches that hang over the water are less accessible to rats, weasels, and others of their enemies. Another reason too, on the supposition of their migration, may account for their resorting in autumn to the sides of rivers; for by following the course of the stream they would more readily find their way to the sea. The supposed fact of swallows having been found in a torpid state under water greatly wants confirmation. It is likely enough, indeed, that some have been drowned, while roosting, by the rising tide, and been fished up a few hours after, possibly while even in a state of suspended animation; but their internal structure wholly unfits them for existing for any length of time immersed in water.

A more common opinion than the former is, that those species of swallows above mentioned, *retire, like bats, to caverns and other sheltered places during the cold weather, where they pass their time in a torpid state*, except when revived by a fine day or two they are induced by hunger to make their appearance in the open air; for it is a known fact, and one that happens almost every

year, that a week of tolerably mild weather in the middle of winter never fails to bring out a few swallows, who disappear again on the return of the frost; there are also a few sufficiently authenticated instances of swallows having been found torpid in the shafts of old coal pits, and cliffs by the sea side. The facts as far as they go are conclusive, namely, that some individuals of these species pass the winter in this country in a torpid state, but the instances are by no means sufficiently numerous to preclude the necessity of disposing of the main body in another way, for from their multitudes, if they all never quitted this country, it ought to be by no means an uncommon thing to discover them in their winter abodes, especially as of late years they have been accurately searched for, and the holes of the sand martins have been repeatedly laid open, without the smallest success.

Concerning the third hypothesis, the *migration* of the swallow tribes, it may be observed, that all the birds of this genus are far better flyers than many others, whose migration is universally allowed, and that the deficiency of food is a very sufficient motive to induce them to retreat to warmer climates; that the sudden appearing in spring of the main body, and their disappearing in autumn, together with the occasional apperance of a few during mild weather in the winter months, speaks loudly in favor of migration. But there are yet other more decisive facts to be related in proof of this opinion. Mr. White, one of the most accurate observers that this country has produced, in his "Natural History of Selborne," says, "If ever I saw any thing like actual migration it was last Michaelmas-day. I was travelling, and out early in the morning. At first there was a great fog, but by the time I was got seven or eight miles towards the coast, the sun broke out into a delicate warm day. We were then on a large heath or common, and I could discern, as the mist began to clear away, great numbers of swallows, (hirundines rusticæ,) clustering on the stunted shrubs and bushes, as if they had roosted there all night. As soon as the air became clear and pleasant; they were all on the wing at once, and by a placid and easy flight proceeded on southwards towards the sea. After this I did not see any more flocks, only here and there a straggler."

Having thus launched our swallows, let us follow them in their course across the sea. In the spring of the year, Sir Charles Wager on his return up the channel from a cruise, during some very stormy weather, as soon as he came within soundings, fell in with a large flock of swallows, which immediately settled, like a swarm of bees, on the rigging. They were so tired as to suffer themselves to be taken by hand, and so much emaciated from the long continuance of heavy gales that they had had to contend with, as to be reduced to mere skin and bone. After resting themselves for the night they resumed their flight next morning.

Willoughby, the first British ornithologist, during a visit in Spain, observed a multitude of half-starved swallows, in the province of Andalusia, on their progress to the south; and the brother of Mr. White, before mentioned, had ocular demonstration, during the spring and autumn, of the migration of birds across the Straits, among which were myriads of the swallow tribe, and many of our soft billed birds of passage. In passing these Straits they scout and hurry along in little detached parties of six or seven in a company, and sweeping low, just over the land and water, direct their course to the opposite continent, at the narrowest passage they can find. They usually slope across the bay to the south-west, and so pass on to Tangier.

From all the above considerations, it seems to be pretty evident that swallows do not spend the winter under water; that a few, probably some of the later brood, remain with us during the winter, for the most part in a state of torpidity, but that the main body migrates across the channel to Spain, and thence at Gibraltar passes to the northern shores of Africa, returning by the same road in the spring to Great Britain.

The opinion that swallows migrate to warmer climes at the approach of winter is supported by Marsigh, Ray, Willoughby, Catesby, Reaumur, Adamson, Buffon, &c. Pennant and White were of opinion that some of them migrated, and that others remained torpid in the holes of caverns and trees. The third opinion; viz. that swallows lie in a torpid state at the bottom of lakes and rivers is adopted by Schæffer, Hevelius, Derham, Klein, Ellis, Linnæus, and Kalm.

PERMANENT ELECTRO-MAGNETS.

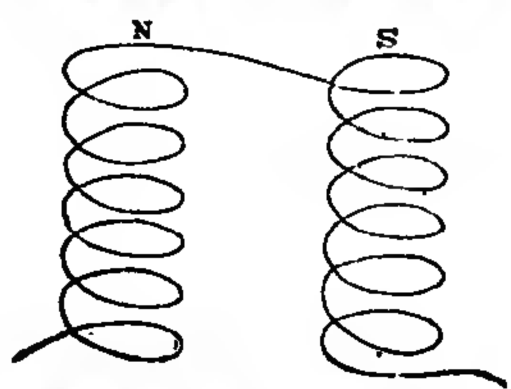
BY MR. J. L. SMITH.

Ever since galvanism has been known to produce magnetism, especially under certain forms of apparetus, it has been a great desideratum to retein, permanently, the great power that is generated within the limite of a few square inches of metal.

A few years since, having seen what an intense degree of magnetic force could be generated in a bar of soft iron, by passing galvanic currents around it; the idea (very natural to most persons witnessing the same experiment) occurred to me, whether this magnetism could not in some manner be retained; I was aware that so long as soft iron was made the agent it could not; and if tempered steel was used a difficulty would also present itself, and it was not till about eight or ten months since that the following experiments were put into operation. The object that I had in view was to substitute for the iron used in the electro-magnet, red hot steel and cool it suddenly.

A few feet of copper wire were coiled as shown in the figure, the arrangement being such that the galvanism in its circuit would generate north and south polarities, at the end of the respective coils.

Positive Pole. Negative Pole



The coils were varnished in order that they might be immersed in water, without any interruption taking place in the current of the galvanic fluid. The two extremities of the wire were attached to a battery, consisting of a single pair of plates, each plate of about twelve square inches. A horse-

shoe of soft iron was then introduced into the coils to test their magnetic power; the iron was found capable of sustaining about one and a half pounds. After withdrawing the iron, a piece of steel, of the same shape, made red hot, was introduced, and both steel and wire were plunged into cold water, and contrary to my expectation, the steel was found to be but feebly magnetic. I then repeated the experiment, with this difference, that before cooling the steel, I united its two extremities (projecting below the ends of the coils) by a piece of soft iron, which by keeping up the circulation of the magnetic fluid, enabled me to procure a magnet of some power, that is to say, the steel used weighing one ounce, after undergoing this process, was able to sustain six ounces. It must be recollected, that the instruments used were of a rude character, and that they could not create a temporary magnet of more than one and a half pounds power. By this experiment it will be seen that one-fourth the maximum power developed was secured permanently, but it is not to be supposed that in all instances the ratio of the power secured, to the power developed, will be as great as in this, but I believe, if proper proportions be observed in the steel used, there will be an approximation to this ratio, even when the magnetic force is of great intensity.

This method of making magnets may be of some practical utility, for the apparatus required is of the simplest kind, consisting merely of a few feet of wire; moreover the magnets produced are of a greater power in proportion to the generating energy, than those made by any other process with which I am acquainted.

I will here mention an experiment which I have tried in common with others, of making magnets by attaching red hot pieces of steel to an artificial magnet, or to the temporary electro-magnet, and cooling them suddenly.

To an artificial magnet capable of sustaining eight pounds, I applied a piece of ignited steel weighing one ounce, semicircular in form, and immersed it in water; it was found capable of sustaining three ounces, only about one-fortieth of the power used, and in no experiment, although many were made, was the ratio between the produced and the producing powers greater.

The reason of this great disproportion appears to be, that when the metal is raised to a red heat, magnetism is not easily induced in it, and that it is only when it arrives at a lower temperature in the cooling process, that it receives that magnetic virtue which it retains, and this no doubt also accounts for its inferiority to the first method mentioned—for there the galvanic fluid is made to circulate around the steel; and the current of the magnetic fluid is also kept continuous by the soft iron uniting the two poles.—*Silliman's American Journal.*

ANALYSIS OF MINERALS.

(Resumed from page 171.)

TESTS.

The former paper treated of the management of the blow-pipe, as applicable to ascertain the chemical character of mineral substances—a valuable part of analysis, but which must be followed up by processes more particularly chemical, as although the blow-pipe drives off some matters in vapor—deposits others in a metallic form, and otherwise changes the external form and characters—yet tests are indispensable in proving the accuracy of the surmises and opinions, which the action of the blow-pipe enables us to form.

The principal tests necessary are sulphuric, nitric, and muriatic acid—the nitrate of silver—ammonia acetate of lead—tincture of galls—prussiate of potass—nitrate of barytes—and the carbonate of soda. The manner in which they act, and their application in detecting various substances are as follows:—

Sulphuric Acid discovers the presence of many other acids: it detects the *carbonic* by causing a brisk inodorous effervescence: the *nitric* by disengaging fumes, which become orange by contact with atmospheric air; the *muriatic* by white fumes, which become beautifully distinct by holding near them a stopper or feather moistened with ammonia; the *acetic* by the escape of pungent vapors, having the well-known odour aromatic vinegar; and the *fluoric* by the moderate effervescence, arising from suffocating fumes, which rapidly corrode glass exposed to their action.

From *metallic solutions*, it precipitates *lead* and *mercury* in heavy white clouds; they may be distinguished by the *latter* acquiring a yellow tinge when covered with boiling water.

The earths thrown down by this acid are barytes, strontian, and lime; the two first are totally insoluble, but the last is soluble in about 500 parts of water, and even less, if an excess of acid should be present.

Nitric Acid is extremely useful in the examination of minerals, from its powerful action on most of the metals and earths. To use it, place a small portion of the mineral finely powdered in a watch-glass, or small glass tube, and pouring over it a little of the acid, expose the mixture to the heat of a spirit lamp or common candle: the solution is then ready for examination, by exposing small quantities of it separately to the action of the various tests, which is best done in narrow glass tubes, into which about an equal quantity of water may be previously poured.

As a test this acid is of no use, except occasionally to an experienced person. Care should be taken to prevent its touching the fingers, as it stains the skin a deep and permanent yellow.

Muriatic Acid is useful as a solvent, in the same manner as the nitric acid, though some metals, as lead and silver, are not dissolved in it. Tin, on the contrary, is readily soluble in muriatic acid; the action of nitric acid on that metal is very violent, converting it into an insoluble white oxide.

As a test, it discovers silver and lead, with which it forms a white precipitate; the former becomes black by exposure to light, is insoluble in water, and soluble in liquid ammonia; the latter is not affected by light, and is soluble in nitric acid, or in about 25 parts of boiling water: it also detects manganese by the disengagement of chlorine, when exposed to heat with the powder of any mineral containing a considerable proportion of that metal.

Oxalic Acid is used to separate the oxides of titanium or cerium from that of iron, the two former being precipitated, while the iron remains in solution; but the chief application of this acid is for the detection of lime. Oxalate of ammonia being, however, far preferable for this purpose, it may be formed the moment required, by mixing a little of the acid in a tube with ammonia: on adding to it a solution, containing lime, the smallest particle will be discovered; it will show the presence of lime in

almost any spring water. Magnesia, if in any quantity, will be precipitated, but not until after some hours. Should barytes or strontian be present, they must be previously removed by sulphuric acid.

Nitrate of Silver is a most delicate test for muriatic acid, with which it forms a white curdy precipitate, which speedily blackens by exposure to light. With sulphuretted hydrogen, or any sulphurets, it forms a black cloud, and with chromic acid a carmine red precipitate.

Ammonia is chiefly useful for the detection of copper and nickel; when added in excess to any solution containing those metals, they will be re-dissolved of a beautiful bright blue: to distinguish the copper from tha nickel, add sulphuric or nitric acid till tha color has disappeared, and on immersing a bar of zinc, the copper will be precipitated, but not the nickel. Many other metals are thrown down by this test: as mercury, of a white color, which turns brown; silver, grey; iron, brown; platina, buff; zinc, white, which re-dissolves in excess of ammonia.

Acetate of Lead discovers carbonic, muriatic, or sulphuric acid, by a white precipitate: the carbonic is known by the precipitate effervescing with nitric acid: the muriatic by its being soluble in acetic or dilute nitric acid which that produced by the sulphuric acid is not. Should a mineral contain *phosphoric* acid, a white precipitate will be formed, which may be known by the following characters: heated by tha blow-pipe on charcoal, it forms a pearly globule, which assumes a polyhedral form immediately the heat is discontinued; on again applying the blow-pipe, the phosphoric acid is decomposed, burning away with the smell of phosphorus, and a globule of pearl lead is left. This is a very delicate test for sulphuretted hydrogen, or sulphurets in generel, forming with them a black cloud.

Tincture of Galls is a valuable test, from its extensive application to metallic solutions; but as it is influenced by the presence of other bodies, it will be well to neutralize very carefully any excess of acid, (with the carbonate of soda) previously to using the test. Tha metallic precipitates are: lead, white; cobalt, yellowish white; nickel, greyish white; bismuth and mercury, orange; silver, yellowish brown; chrome, brown; copper, brownish; molybdena, deep brown; titanium, reddish brown; uranium, chocolate; platina, dark green; iron, black—for the latter it is a very delicate test.

Prussiate of Potash is on the whole the most valuable test possessed by the minerelogist, from the immediate and characteristic effect produced on nearly all the metallic solutions, without the disadvantage of having its effect much impeded by foreign bodies, as is the case with tinctura of galls. With iron it forms at once the vivid tint of Prussian blue; with antimony, arsenic, lead, silver, tin, and zinc, its precipitates are white: (if these metals are impure the precipitates are more or less colored); bismuth and manganese, yellowish white; cobalt, brownish yellow; chrome, green; nickel, sea-green; titanium, grass-green; copper and molybdena, brown; uranium, reddish brown.

Nitrate of Barytes is a useful test for the discovery of sulphuric acid, with which it forms a heavy white precipitate insoluble in water or acids, but melting before the blow-pipe into an opaque milky globule; the carbonates also throw down a heavy white powder, but it is immediately known by its being re-dissolved with effervescence in nitric or muriatic acid. This test is frequently serviceable for freeing nitric solutions from the admixture of sulphuric acid, which arises from the oxygenation of the sulphur when the metallic sulphurets ara exposed to the action of that acid.

Carbonate of Soda throws down a white precipitate with lead, titanium, and uranium; a peach or lilac one with cobalt, and a blue one with copper; it should also be kept for tha purpose of neutralizing occasionally the excess of acid in metallic solutions, which, if considerable, always more or less affects the action of other tests. It is sometimes useful as a flux for the blow-pipe, particularly in the examination of the ores of tin.

ON THE CLOUDS, &c., AS PROGNOSTICS OF THE WEATHER,

BY J. A. SPENCER.

To those whose engagements may be at all influenced by the weather, a knowledge of the formation of the clouds is extremely useful, as they are the unvarying indicators of the changes in the atmosphere.

There are seven modifications of clouds—three simple, two intermediate, and two compound.

I. The Simple – 1. Cirrus. 2. Cumulus. 3. Stratus.

II. The Intermediate.—1. Cirro-Cumulus. 2. Cirro-Stratus.

III. The Compound.—1. Cumulo Stratus. 2. Cumulo-Cirro-Stratus, or Nimbus.

The Cirrus is a combination of fibres, either parallel, or diverging: it is generally the highest of all clouds, and sometimes extends over more than half the hemisphere, although at others it is only here and there pencilled in the clear blue sky. Dr. Forster has divided the Cirri into three classes. the Reticular, the Comoid, and the Filiform Cirri. The Reticular Cirrus has, as its name implies, tha appearance of a net. The Comoid Cirrus that of a distended lock of hair; and the Filiform Cirrus that of bundles of thread.

The Cirrus is generally the harbinger of wind, and when it descends lower than usual we may predict a storm.

The Cumulus consists of convex heaps, rising from a horizontal base. This cloud is generally formed in the lower regions of the atmosphere. When the harbinger of rain, the surface of tha Cumulus has a very fleecy appearance. In dry weather the surface is well defined and rounded. It frequently remains during the whole day.

The Stratus is a horizontal sheet of clouds, formed near the surface of the earth. It includes those mists which frequently arise from low and damp situations. It generally rises about sunset, and disappears soon after sunrise. The appearance of the Stratus is generally followed by a fine day.

The Cirro-Cumulus consists of small roundish masses. It is formed from the Cirrus. This latter cloud is frequently seen to lose its fibrous nature, and form itself into globular and irregular masses; this is the Cirro-Cumulus. It is frequently seen in summer, and is generally followed by fair weather, but when seen together with the Cumulo-Stratus it is the sure forerunner of a storm.

The Cirro-Stratus.—The forms in which the Cirro-Stratus appear are very various. Lika the Cirrus, from which it is frequently formed, it con-

sists of fibres, though they are generally denser and better defined than those which form the Cirrus. This cloud has frequently the appearance of a shoal of fish, and has been called by some, "The Mackerel-black Sky." At other times it presents the appearance of a tumbling sea, and is then mostly attended by an increase of temperature and thunder storms. Rainy and windy weather generally follow the appearance of the Cirro-Stratus.

The Cumulo-Stratus is composed of the Cirro-Stratus, blended with the Cumulus. It frequently presents the appearance of vast banks of clouds, with overhanging masses. The Cumulo-Stratus opens a wide field for the exercise of the imagination, in tracing the outlines of cities, towns, mountains, giants, and fairies. But, alas! these appearances are but momentary, as the Cumulo-Stratus is constantly changing its form. It is to this cloud only that the following description of Shakespeare will apply :—

> "Sometimes we see a cloud that's dragonish:
> A vapour, sometimes like a bear or lion.
> A towered citadel, a pendent rock,
> A forked mountain, a blue promontory
> With trees upon 't, that nod unto the world,
> And mock our eyes with air.
> That which is now a horse, even with a thought,
> The rack dissolves, and makes it indistinct,
> As water is in water."

This cloud is seen in all countries subject to sudden and repeated changes in the atmosphere. It predicts neither fair nor foul weather.

The Cumulo-Cirro Stratus, Nimbus, or Rain Cloud, is a system of clouds from which rain is falling. The Cirrus stretches above it, while the Cumulus enters it from beneath. This latter cloud is frequently seen to rise in towering masses in the air, and there take the form of the Cumulo-Stratus. This soon becomes more dense, and forms the Nimbus. During the formation of the Cumulo-Stratus, the Cirro-Stratus frequently caps it. There is no cloud so easily distinguished as the Nimbus, and even those who are unacquainted with its structure can generally detect it. The lower part is black and well defined, while the upper is surrounded by mist.

The following methods of prognosticating the weather, by the appearance of the heavenly bodies, are extracted from an old work, entitled "One Thousand Notable Things."

To tell the weather from the Sun :—"If the sun rise red and fiery expect wind and rain." "If at sun-rising it be cloudy, and the clouds disappear, as the sun rises higher, it is a sure sign of fine weather." "If the sun set red, it is a sign of fair weather." "If it set in a muddy misty color, it is a sign of rain."

To tell the weather by the moon :—"If the moon shine clear, and not encompassed about with mists, it will be fair weather." "If the moon is misty or dim, wind, rain or snow, follows within twenty-four hours."

To tell the weather by the Stars :—"The stars more bright than ordinary in summer signifies great winds and wet." If they twinkle or blaze in winter, the wind north or east, is a sign of great frost." "When they are seen to fall or shoot, is a sign of a great rain and winds."

To tell the weather by the Rainbow :—"If two rainbows appear, signifies fair for the present, and two or three days after rain." "A rainbow appearing after a long drought is a sign of rain; but after a long time of wet, fair weather." "If it appear big, it is a sign of much wet; but if very red, of wind." "If it appear in the morning, it is a sign of small rain, and presently after fair weather."

To tell the weather from the clouds.—"If they are round, and of a dapple grey color, (Cirro-Cumulus,) and the wind north or east, fair weather for two or three days after." "If they appear like towers or rocks (Nimbus) it is a sign of much rain." "If clouds that are small, (Cumulus,) grow bigger and bigger, it is a sign of much rain; but if great clouds waste and grow less it is a sign of fair weather."

To tell the weather from Mists :—"If they arise from rivers and ponds, and then vanish, fair weather." "If from thence to the hill-tops, rain the same day, or two days after." "If a general mist before sun-rising, near full moon, signifies fair weather; but if such a mist in the new of the moon, signifies rain in the old of the moon: but in the old of the moon, signifies rain in the new."

AMUSING EXPERIMENT.

Half fill a Florence flask with water; place it over a lamp, and let it boil for a few minutes; then cork the mouth of the cask as expeditiously as possible, and tie a slip of moist bladder over the cork to exclude the air. The water being now removed from the lamp the ebullition will cease; but may be renewed by pouring cold water gradually upon the upper part of the flask; but, if hot water be applied the boiling ceases. In this manner the ebullition may be renewed and again made to cease, alternately by the mere application of hot and cold water.

The theory is this: water boils at 212°, under the common pressure of our atmosphere; now, if the atmosphere, or a part of it were removed, the pressure on the surface would be less, and the consequence would be that water would boil at a much lower temperature; and this leads us to an explanation of what takes place in the foregoing experiment. We fill a flask half full of water, and boil it for a few minutes over a lamp; the steam which rises forces out the atmospheric air and occupies its place; we then remove the lamp and secure the flask so as to prevent the re-admission of atmospheric air. If cold water be poured over that part of the flask occupied by the steam, the cold water will condense it, and thus a vacuum will be formed. The water then having no pressure of atmospheric air, or steam, commences boiling afresh; but if hot water be poured upon it, the steam again occupies the surface, and the boiling ceases.

PAINTING MAGIC LANTHORN SLIDERS.

To the Editor.

Sir,—The directions given in No. 5, recommending oil colors for painting magic lanthorn sliders, are not altogether correct. The following which I believe have never been before published in any book, and which are very carefully kept secret by the trade, may be depended upon.

Provide a small muller, and a piece of thick ground glass, 5 or 6 inches square, to grind the colors on, a small pallet knife, and a few small bottles to put the colors in. For red get a drop of

scarlet lake. Blue, take Prussian blue. Yellow, take gamboge. Green, take a piece of distilled verdigris, and grind it with a quarter of its bulk of gamboge. Brown, burnt umber and burnt sienna—black, lamp black. These are the only colors that are transparent, and fit for painting sliders.

Having all your colors, grind them in balsam of Canada, mixed with half its bulk of turpentine, or a little more, if too thick for grinding easy, or use mastic varnish, which will get harder sooner than the other, as it will take six or seven days to harden; but the balsam is more beautiful. To paint the glass black round the painting, dissolve asphaltum in turpentine, mixed with lamp black. Having ground all your colors put them in each bottle. When used take a little out with a bit of stick, on a piece of glass, not more than you want, as it dries very soon. If too thick dilute it with turpentine.

To paint the sliders you must design your subject on paper, place it under the glass, and paint upon the glass according to the design beneath.

A CONSTANT READER.

MISCELLANIES.*

Coal Mines of Bohemia.—The following is an interesting description of the vegetable appearances presented by this mineral in a place where the traces of its origin are more distinctly observed than in others: "The finest example I have ever witnessed is that of Bohemia just mentioned. The most elaborate imitations of living foliage upon the painted ceilings of Italian palaces, bear no comparison with the beauteous profusion of extinct vegetable forms with which the galleries of these instructive coal mines are overhung. The roof is covered as a canopy of gorgeous tapestry, enriched with festoons of most graceful foliage, flung in wild irregular profusion over every portion of its surface. The effect is heightened by the contrast of the coal black color of these vegetables with the light ground work of the rock to which they were attached. The spectator feels himself transported, as if by enchantment, into the forests of another world; he beholds trees, of forms and characters now unknown upon the face of the earth, presented to his senses almost in the beauty and vigor of their primeval life; their scaly stems and bending branches, with their delicate apparatus of foliage, are all spread before him, little impaired by the lapse of countless ages, and bearing faithful records of extinct systems of vegetation, which began and terminated in times of which these relics are the infallible historians. Such are the grand natural *herbaria*, wherein these most ancient remains of the vegetable kingdom are preserved in a state of integrity little short of their living perfection under conditions of our planet which exist no more."—*Dr. Buckland's Bridgewater Treatise.*

Ink for Writing on Zinc Labels.—Reduce equal parts of verdigris and sal-ammoniac to powder; add a fourth part of lamp black, and five parts of water. Mix the composition well in a stone mortar; add the water gradually, and take care to shake the composition before it is used.

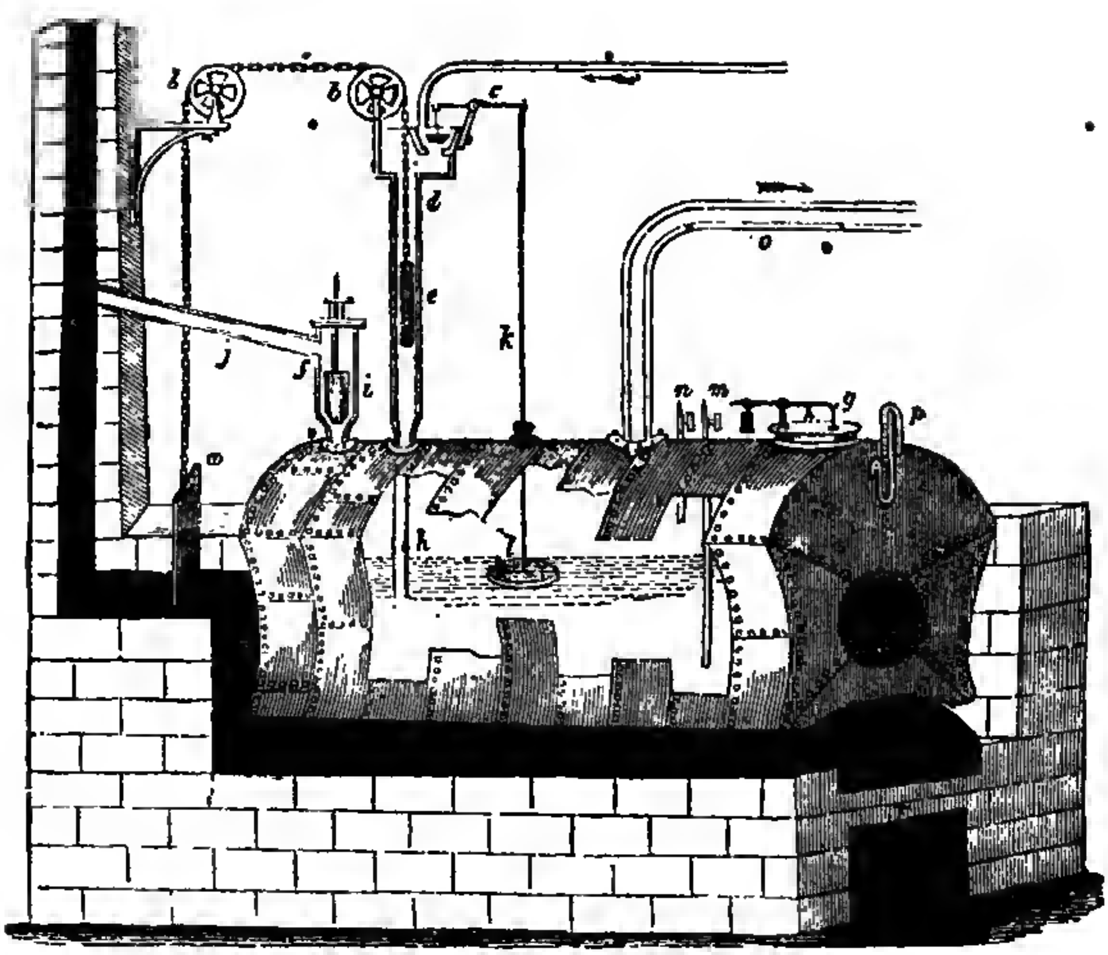
Consumption of Staple Articles in England.—The following is an accurate estimate of the home consumption of England in the great staple articles of commerce and manufactures. Of wheat fifteen million quarters are annually consumed in Great Britain; this is about a quarter of wheat to each individual. Of malt twenty-five million bushels are annually used in breweries and distilleries in the United Kingdom, and there are forty-six thousand acres under cultivation with hops. Of the quantity of potatoes, and other vegetables consumed, we have no accounts. Of meat about one million two hundred and fifty thousand head of cattle, sheep, and pigs are sold during the year in Smithfield market alone, which is probably about a tenth of the consumption of the whole kingdom. The quantity of tea consumed in the United Kingdom is about thirty million pounds annually. Of sugar nearly four million hundred-weights, which is a consumption of twenty pounds for every individual, reckoning the population at twenty-five millions: and of coffee about twenty million pounds are annually consumed. Of soap one hundred and fourteen million pounds are consumed: and of candles about one hundred and seventeen million pounds. Of clothing we annually manufacture about two hundred million pounds of cotton wool, which produces twelve hundred million yards of calico and various other cotton fabrics, and of these we export about a third, so that eight hundred million yards remain for home consumption, being about thirty-two yards annually for each person; the woollen manufacture consumes about thirty million pounds of wool.

Gallic Acid speedily prepared.—According to Dobereiner, gallic acid may be prepared by mixing a concentrated infusion of galls with acetic acid, in order to decompose the gallate of lime; it is then to be shaken for a few minutes with ether, which takes up much gallic acid; the ether is to be slowly evaporated, and gallic acid is obtained in a very short time in small colorless crystals.

To stop the Ravages of Caterpillars from Shrubs, Plants, and Vegetables.—Take a chafing dish, with lighted charcoal, and place it under the branches of the tree, or bush, whereon are the caterpillars; then throw a little brimstone on the coals. The vapour of the sulphur, which is mortal to these insects, and the suffocating fixed air arising from the charcoal, will not only destroy all that are on the tree, but will effectually prevent the shrubs from being, at that season, infested with them. A pound of sulphur will clear as many trees as grow on several acres.

Another method of driving these insects off fruit-trees is, to boil together a quantity of rue, wormwood, and common tobacco (of each equal parts), in common water. The liquor should be very strong. Sprinkle this on the leaves and young branches every morning and evening during the time the fruit is ripening.

Portable Barometer.—This instrument consists in general of a tube, of the usual length, passing through the upper parts of a wooden cistern, to which it is glued, and the bottom of which is made of leather. The tube being filled with mercury, which has been previously well purged of air, and placed in a proper position, the superfluous mercury descends into the cistern, and assumes a level in the tube corresponding with the weight of the external air. The surface of the mercury in the cistern is adjusted to the same level by a screw, which presses more or less against the flexible leather at the bottom, and raises or depresses it at pleasure. From the line of this level, which is called zero, the scale commences and is reckoned upwards to the height of about 32 inches; the actual divisions of the scale begin at about 15 inches.



THE STEAM-ENGINE BOILER.

The ateam-engine consists of two distioct parts, in one of which a due supply of steam is generated—io the other this steam is applied to put in motion a beam or a wheel, which by its alternate or rotatory motion acta as a prime mover of any machioery attached to it. In some instances these two parts appear inseparably connected, as, for example, in the locomotive enginea. Thia, however, is not the case, as the boiler is here made only to act as points of supports for the other parts. To underatand then the structnre of the ateam-enginc, it is neccssary to treat of each aepsrately. At preaent we shall confine ourselvea to the hoiler.

This is the vessel in which the steam is generated, aud forms an exceedingly interesting part of the steam-engine. Nothing can he more beautiful than those adjustments of the hoiler and cylinder to each other, hy which the engine itself regulates the supply of steam to the cylinder, of water to the boiler, und of heat to the furnace. It thus, in a manner, itself proportioos the supply to the demand; and with so much regularity and precision, that the engine in its movements almost rivals the voluntary motions of living heings. The hoiler now to he described is that of land engines, acting on the principle of condensation ; *low-pressure engines*, or *condensing engines*, as they are generslly termed. The hoilers of marine condensing engines are similar in their coostruction, varying a little in form.

The hoiler is a large vessel formed of aheet-iron plates hammered together. Its shape will be understood from the adjoining plate. The hoiler haa two principsl tuhes, one of which conveys to it water to he formed into steam, while the other conveys the ateam from the boiler to the cylinder. These are the tuhea with the arrowa, in the figure. It has guage-cocka to ascertain the height of the water in the hoiler; a steam-guage, to indicate the elastic force of the steam ; a aafety-valva, to givo exit to the steam, and prevent the explosion of the hoiler ; an internal aafety-valve, to give access to the air, and prevent tha compression of the sides of the hoiler hy atmospheric pressure, should the elastic force of the steam in the interior he suddenly much diminiahed from any canse ; and a man-hole, hy which admission may he had to clean the hoiler when necsssary. The boiler is placed upon s fornace, anpplied with a aelf-acting damper; and, by Brunton's contrivance, may he made to feed itself with fuel, according to the demand.

The Feed-pipe.—The tube *e* which conveys the water into the boiler is termed the feed-pipe. It proceeds from a cistern *d* placed above the boiler, and terminates a little lower than half-way between the top and bottom of the boiler. The cistern *d* is freely supplied with hot water by the pipe which proceeds from the hot well, and conveys (by a pump worked by the engine,) the warm water of the hot well to the cistern. The water thus conveyed to the cistern would fall directly down into the boiler by the pipe e were it quite open. But as the demand for steam is not always the same, and it will not therefore do to have a *constant* quantity of water supplied to the boiler, too much water might enter the boiler; or there might be too little and the boiler might then be injured by the heat. The feed-pipe, to prevent such irregularities, and proportion the supply of water to the demand, is rendered self-acting in the following manner. At the bottom of the cistern *d* a valve is placed, which opens upwards when the rod which attaches it to the lever c is raised, and admits water from the cistern to the tube *e* below it. The lever, as will be seen, moves on a fixed point at the upper part of the cistern. To one extremity of the lever a small rod or wire *k* is attached, which passes through an air-tight aperture into the boiler, supporting a stone-float at its extremity. This stone-float is counterpoised by a weight *l*, attached to the other end of the lever c. The weight is such as to balance the float *in water*, and, accordingly when the level of the water becomes lower from so much being formed into steam, the float will descend, (as the weight cannot support it in air.) The float descending will pull down the arm of the lever to which it is attached, elevate the other arm, and thus open the valve in the cistern, so that water will pass from it into the boiler. When the float has been thus raised sufficiently, the weight will then pull down its arm of the lever and shut the valve, so that no water will enter. In this manner the water is kept always near the same level in the boiler. The cistern is supplied abundantly with water by the pipe from the *hot well*, as it is called, the water in which is warm; so that there is a gain of heat proportioned to the excess of the temperature of the water thus pumped in over the usual temperature of water.

Connected with the feed-pipe of the boiler, there is a contrivance of great ingenuity called the *self-acting damper*. If the quantity of water supplied be uniform, the amount of steam produced will vary according to the intensity of the fire. If the fire be too strong, more steam will be formed than is required—if weak, too little steam will be produced. By a *damper*, which contracts or enlarges the throat of the flue of the furnace, the strength of the fire may be increased or diminished, and the quantity of steam will vary accordingly. As the steam in the boiler presses on the water, this water will rise in an open tube to which it has access to a height proportioned to the pressure. The feed-pipe *e* is such a tube: in it a weight is suspended, connected by a chain with a damper *a*. The chain passes through a separate tube in the cistern *d*, and over two pulleys *b*. The weight *f* is such as just to balance the damper *a* when immersed to a certain extent in water in the tube *e*, forced up by the elastic force of the steam. Let the weight and damper be adjusted to the required force of the steam, and be in a state of rest. They will remain so until some change in the strength of the steam arises. Should its elastic force be increased, the water will be forced up in the tube; the weight, (or a greater part of it) being now supported by water will be lighter in relation to the damper which is entirely suspended in air; the damper will therefore descend and contract the throat of the flue of the furnace; the draught will thus be diminished, the fire moderated, and less steam formed. Should the elastic force of the steam be diminished, the water will sink in the tube, the weight will descend, the damper will be raised, the draught be increased, the fire burn more briskly, and more steam will then be formed.

In the boiler, two tubes, or *guage-pipes*, *m n*, each furnished with a stop-cock, are placed vertically, for the purpose of ascertaining the quantity of water in the boiler. They are made of such length that the extremity of the short one is a little above, and that of the long one a little below the proper level of the water. Accordingly, when the boiler is heated, if the water be at its proper level, on opening the cocks of the two guage-pipes water will be discharged from the longer one, and steam from the shorter one. If the water be too low steam will issue from both pipes; if too high, water will be discharged from both pipes. The water rises in and is discharged from the pipes by the elastic force of the steam which occupies the upper part of the boiler. This method of ascertaining the level of the water was proposed by Savery. It is still in use.

Steam-Guage.—This is seen at *p*, at the right of the boiler. It is fixed into the boiler, or some tube freely communicating with it, and is open at both ends. It is curved, in the form of the letter *u*, and contains a quantity of mercury. The atmospheric pressure acts on the mercury in the limb open to it, with a force of 14.7 pounds per square inch. If the steam act with the same force, the mercury will be at the same level in both limbs. If the steam be of higher elastic power than the air's pressure, it will depress the mercury in the limb on which it acts, and force it up to a corresponding height in the limb open to the air. The difference will indicate the excess of the force of the steam over the air's pressure. The tube may be of glass or iron. In the latter case, a float rests upon the surface of the mercury exposed to the air, which rises or falls with the mercury; and, the upper extremity of the float having a scale adjoining, it acts as an index, and shows the height of the liquid within the tube.

Safety-Valve.—The object of this valve is to permit the escape of steam, should it accidentally become stronger than the boiler is intended to bear, and thus prevent the bursting or explosion of the boiler. It is a valve so loaded as to open with a pressure of steam, a little more than is necessary to work the engine, and considerably less than the utmost the boiler can bear. The steel-yard safety-valve is much employed. This consists of a lever, the joint or fulcrum of which is set on a support at the side of a short tube or pipe communicating with the boiler. From the lever immediately over the aperture of the tube, a rod descends, having a plug attached, which closes the tube. To the other extremity of the lever, weights may be attached, at distances from the fulcrum, which will have power in keeping down the valve or plug, in proportion to their distance from the fulcrum. The force of the steam will tend to push up the plug, (valve,) and permit the escape of the steam; the atmospheric

pressure, and the weight attached to the lever, will tend to press down the plug, and prevent the exit of steam. The valve will be open or shut, according to the relative strength of these forces acting on it in opposite directions. In steam-boat engines, a conical plug is used, from which a rod rises, on which circular weights are placed, perforated so that they can easily be slipped off or on the rod. The weights are thus placed above the valve, and, when set, cannot shift. In the steel-yard valve, the weight slips along the arm of the lever, and thus acts with greater force; just as if more weights had been laid on. Sometimes the valve becomes ineffective, from being corroded, and sticking to the tube. It is considered that explosions of steam-boilers, in those cases where the valve has not been rashly overloaded, nor become corroded, are owing to the sudden formation of a large quontity of steam, which cannot escape with sufficient rapidity by the valve. The sudden formation of a great volume of steam, is, most probably, owing to the water being too low, the boiler too highly heated, and the water then being thrown up upon the sides. It has been conjectured that explosions may sometimes be owing to the decomposition of the steam, or water, by the hot sides of the boiler. This may take place; but it is not easy to see how this would produce gas of greater elastic force than if the decomposed water had been formed into or remained steam. A second description of valva is seen at *f*, which acts in the same manner as the tube connected with the domper. *f* is a tube with a weight to it, *i*—this weight rises when the pressure of the steam is high, and suffers it to pass along the tube *j* into the chimney *s*.

Internal Safety-Valve.—The valve just described opens outwards. There is another which opens inwards, therefore termed the internal safety-valve. The use of this valve is to admit the air to the interior, should the steam be suddenly condensed from any cause. Were there no such contrivance, the atmospheric pressure on the external surface of the boiler, (14.7 lbs. on every square inch,) might crush the boiler on any sudden diminution of the elastic force of the steam. But the internal valve yields, and admits air when the internal pressure on it is much diminished, and thus produces an equilibrium. The internal safety-valve is shown ot *g*.

The Man-Hole.—The large opening ot *g* is to give entrance to the interior of the boiler, for tha purpose of cleaning it. This is an operation performed at longer or shorter intervals, according to the quality of water employed for the production of the steam. If the water contain much saline matter, the boiler must be cleaned frequently, otherwise there is a great waste of fuel in heoting the water through the crust which forms at the bottom, and also a risk of burning the boiler, as, if the heat is not quickly carried off from the boiler in the form of steam, the metal becomes too hot, and is then more apt to oxidate, (rust.) Also, from being too hot, it causes a risk of an explosion.

The Furnace.—The furnace, above which the boiler is placed, differs from a common fire-place in being entirely excluded from the air, except at two parts:—*First,* at the grating, or furnace-bars, on which the fuel rests, and between which air enters and supports the combustion; *second,* at the throat at the bottom of the chimney, where the smoke and products of the combustion quit the furnace. Thus no cold air is admitted into the chimney or above the fire, os in a common fire-place; and hence the draught is more powerful, air supplied more quickly to the fuel, and the heat produced more intense. *r* is the door of the furnace, by which fuel is introduced. The damper, by which the current of air is increased or diminished, is shown at *a*. There are many contrivances for preventing smoke. This is effected by constructing the furnace so that the fresh coal is introduced *below* the ignited coal by which the smoke arising from the fresh coal is burnt or consumed as it rises. Considerable saving is effected in this manner, as tha smoke contains much charcoal in suspension, in fine powder—much fuel being thus lost in ordinary smoking furnaces. The principle of Witty's smoke-consuming furnace will be readily understood, if we conceive a common fire to be mended by pushing fresh coals in *below,* instead of laying them on at the top. To save heat the furnace is often placed inside the boiler, and the flue also conducted through the boiler.

A very ingenious furnace has been constructed by Mr. Brunton, of Birmingham, which may be termed a self-feeding furnace. He made the furnace circular, and connected to it a hopper placed above, which supplied it with coals. The furnace was made moveable, and caused to revolve, by being connected with the steam-engine; and thus a very uniform supply of heat was supplied to the boiler above. In each revolution, the hopper opened, and discharged coals into it, and this feeder was regulated by communication with the damper; so that the quantity of coals was increased or diminished according to the demands of the engine.

DIORAMIC PAINTING.

BY M. DAGUERRE.

THE principles of this new art hava been most admired, or perhaps most fully developed, in the following pictures:—*The Midnight Mass—Landslip in the Valley of Goldau—The Temple of Solomon*—and *The Cathedral of Sainte Marie de Montreal.** Each of these paintings has been exhibited with the alternate effects of night and day gradually stealing over them. To these effects of *light* were added others, arising from the decomposition of *form*, by means of which, as for example in the *Midnight Mass*, figures appeared where the spectators had just beheld seats, altars, &c.: or again, as in *The Valley of Goldau*, in which rocks tumbling from the mountains replaced the prospect of a smiling valley.

I. *Pictorol Processes.*—The canvas is painted on both sides. In this case, therefore, whether the subjects be illuminated by reflected or refracted light, one indespensable essential is, to employ a medium or canvas which is exceedingly transparent, ond the texture of which is as equal as possibly can be obtained. Either lawn or calico may be used. It is also necessary to choose those stuffs of the greatest width that is manufactured, to avoid seams, which are always difficult to conceal, especially in the principal lights of a picture.

When the canvas thus selected is stretched, it is necessary to prime it, on both sides, with at least two coats of parchment size.

First Effect.—The first effect, which ought to be the clearer of the two, is executed on the right side of the canvas. The sketch is first made in black-lead, taking care not to sully the canvas, the whiteness of which is tha sole resource possessed by

* These allude to the Diorama at Paris, of which M. Daguerre is painter and proprietor.

whiteness of which is the sole resource possessed by the artist for bringing out the lights of the picture; for white cannot be used in executing the first effect. The colors which I use are ground in oil, but laid upon the canvas with turpentine, to which I sometimes add a little animal oil, but only for deep shadows, and these latter may be varnished without injury. The manipulation is exactly the same as in water-color painting, with this difference only, that the colors are prepared with oil instead of gum, and applied with turpentine instead of water. It will readily occur to the artist that he can employ neither white nor any opaque color whatsoever by coats, which in the second effect would occasion spots more or less tinted, according to the greater or less degree of opacity. It must be the endeavour of the artist to bring out effects at a stroke—at once; going over an effect injures the transparency of the canvas.

Second Effect.—The second effect is painted on the wrong side of the canvas. The artist in executing this part of his work must employ no other light than that which comes from the front of the picture through the canvas. By this means the transparent forms of the first effect are seen; these must either be preserved, or painted over, according to the effect intended.

First of all, a wash of some transparent blue is put over the whole canvas. This coating, like the other colors, is prepared in oil, and laid on in essence of turpentine. The marks of the brush are effaced by a huge tool of badger's skin. By means of this coating the seams also are concealed to a certain extent, by taking care to lay it on thin along the selvages, which have always less transparency than the rest of the canvas. When this coating is dry, the alterations intended to be made on the first effect, are sketched out.

In executing this second effect, the artist has nothing to be beyond modelling in light and shadow, without reference to local color or to the colors of the first picture, which are seen by transmitted light as transparencies. This part is executed by means of a tint of which white is the base, with which lamp-black is mixed in order to obtain a grey, the strength of which is ascerained by applying it to the wash of blue on the wrong side, and then viewing it from the right side of the picture, from which position it will not be at all perceptible if of the proper strength. The gradation of tones is produced by the greater or less opacity in this tint. It may happen that the shadows of the first effect interfere with the execution of the second. To remedy this inconvenience, and to conceal these shadows, we can harmonize their force, by using the grey of a corresponding opacity according to the strength of the shadows which it is the intention to destroy.

It will occur to the artist, that it is necessary to urge this second effect to its utmost power. When this general effect of light and shadow is finished on these principles, and the desired effect obtained, the picture may be colored, the artist using only the most transparent tints prepared in oil. It is still a water-color that is to be executed but less turpentine must be used in these glazings, which produce a powerful effect only in proportion as they are repeated several times, and with more of oil than essence. However, for slight effects of color, turpentine is sufficient.

The Eclairage or Lighting up the Pictures.—The first effect painted on the right or front of the canvas is lighted by reflection, that is to say, only by a light which comes from the front, while the second effect — that painted on the wrong side receives its light by refraction; that is, from behind only. In both effects we may employ both lights at once, in order to modify certain portions of the picture.

The light which gives effect to tha painting in front should come from above. The illumination which falls upon the second effect — that painted behind, should come from vertical openings, it being always understood that these are to be completely closed when the first effect is only seen.

If it happen to be necessary to modify a part in the first effect or picture by a light belonging to the second, that is, coming from behind, then this light must be inclosed so as not to fall, except on the proper place. The windows or openings ought to be distant from the paintings at least two metres, (between seven and eight feet English,) in order to give a power of modifying the light by transmitting it through colored media, as the exigencies of the desired effects may demand. The same means are requisite for the first effect or front picture.

It is admitted that the colors which appear on objects generally are produced only by the arrangement of the molecules of these objects. Consequently all those substances used in painting are colorless: they only possess the power of reflecting such or such a ray of light which in itself contains all the colors. The more pure these substances are the more decidedly do they reflect the simple colors, never, however, by an absolute or independent property, which by the way, it is not necessary they should do in order to represent the effects of nature.

To explain then the principles upon which dioramic paintings are executed and lighted up, take as an example the effect produced when light is decomposed; that is to say, when a portion of its component rays is intercepted.

Put upon a canvas two colors — the brightest possible—the one red, the other green, both as near as may be of the same intensity. Now interpose a red medium, as a colored glass, in the stream of light which falls upon them — what happens? The red color reflects the rays which belong to it; the green remains black. Reverse the experiment by interposing a green glass - the effect is also reversed; the green color gives forth its proper reflection; the red is now black. The effects, indeed, are not perfect unless the interposed media completely exclude all rays but their own, a condition not easily obtained, for colored media have rarely the power of excluding all but one ray. The general effect, however, is sufficiently determined.

To apply this principle to dioramic paintings though in these paintings there are only two effects represented, one of day in front, one of night behind. These effects not passing the one into the other without a complicated combination of the media which the light had to traverse, produce an affinity of other effects similar to those which nature presents in her transitions from morning to night, and the reverse. It must not be imagined that it is necessary to employ media of very intense hues in order to obtain striking modifications of color, for often a slight shade in the medium suffices to operate a very great change in the effect.

It will be understood from these principles of dioramic art in which striking results are obtained

by a single decomposition of light, how important it is to observe the aspect of the sky when we would appreciate the tone of a picture, whose coloring matters are thus subject to decompositions so great. The best light for this purpose, is that from a pale sky; for where the sky is blue, it is the blue tone of the picture also, and consequently its cold tone which comes out most powerfully, while its warm tones remain inactive. Their media are not present, and they are cast comparatively back into neutral tints by the blue medium of the sky—so favorable to the cold tones of the picture. It happens, on the contrary, when the sky is colored, that the warm tones of the picture—its red and yellow—come forth too vigourously, and overpowering its colder tones, injure its harmony, or, it may be, give it quite a different character – a warm instead of a cold tone of color.

It is easy to understand from these observations that the uniform intensity of colors cannot be maintained from morning to evening. We may even venture to assert it to be physically demonstrated that a picture cannot be the same at all hours of the day. This, perhaps, is one of the causes which contribute to render good painting so difficult to execute, and so difficult to appreciate. Painters, led into error by the changes which take place between morning and evening in the appearance of their pictures, falsely attribute these alterations to a variation in their manner of seeing, and color falsely, while, in reality, the change is in the medium—in the light.

THE HYGROMETER.

Any instrument which enables us to measure the quantity of moisture present in the atmosphere is an hydrometer. The proportion of watery vapour held in suspension by the air is very variable, depending as it does, on several causes, none of which affect it more sensibly than change of temperature: it appears from a paper read by Mr. Wood before the Institute of Civil Engineers that the quantity of vapour varies thus:—

At 52° F. it is 160th of the weight of the air.
59 „ 80th „
86 „ 40th „

Hence it increases at a rapid rate as the temperature is elevated which *(cæteris paribus)* is what might be expected. A brisk current of air is also favorable to evaporation, for through its agency the vapour being removed as quick as it is formed, space is afforded for more to rise. Until lately various organic substances, as hair or bone, were used for this purpose; such things contracting in dry weather and expanding in a humid condition of the atmosphere: this was the principle of the hydrometers of Saussure, De Luc, and others. The organic matter having been prepared by immersion in caustic alkali was attached to a moveable hand which worked upon an axis in connexion with a graduated scale. No better illustration can be given of these organic hygrometers than the thin whalebone shavings, which being shaped into different figures, are sold as toys; when placed upon the hot moist hand they curl up, and being removed regain in a short time their original form.

There is however very little dependence to be placed on the hygrometers hitherto noticed; consequently they and all others are now superseded by that invented by Professor Daniell, of King's College. The principle upon which this is constructed is very different from the former ones: when a glass of cold water is brought into a room filled with company, and consequently heated, moisture is soon deposited on the sides of the glass; this, which is dew, is a phenomenon which may be observed by everybody. Let us inquire the cause: The atmosphere of the apartment we may imagine to be saturated with moisture, which remains in a state of vaporation only so long as there is warmth sufficient to maintain it in that condition; when the cold vessel is introduced, a portion of the heat being radiated towards it, and the equilibrium disturbed, the air immediately surrounding the glass is cooled, and being no longer able to hold the vapour in suspension, the latter is condensed in the form of water.

After the above remarks it is hoped that the explanation of Daniell's hygrometer will be intelligible: it consists of two glass bulbs at the extremities of a syphon tube, the arms of which are of different lengths; into this instrument is introduced a quantity of ether, which as it cools, will condense into and half fill the lower bulb: previous to the above operation, a small thermometer is to be fixed in the longer limb of the syphon, having its elongated bulb dipping into the ether, but as close as possible to one side of the larger bulb—the opposite ball of the hygrometer is covered with muslin; when it is to be used the muslin is moistened with ether which by its evaporation produces cold in the empty bulb, and this acting like the cryophorous of Wollaston, causes the inclosed ether to rise in a state of vapour. It is well known that cold is always produced by evaporation, and the temperature of the bulb itself being considerably reduced, the external moisture is condensed; and that it may be noted with the greatest accuracy, a rim of burnished metal is placed round the bulb; by the aid of the thermometer the temperature at which this takes place, and which is called the *dew-point*, can be readily ascertained: as it is convenient to know the difference between the external temperature and the dew-point, a thermometer is usually affixed to the pillar which supports the instrument.

As the preceding description refers somewhat to the formation of dew; it will not be altogether foreign to our purpose if we devote some space to a consideration of this phenomenon. Previous to the investigations of Dr. Wells, the ideas relative to dew were very vague and unsettled; some authorities contending that it arose from the earth, others that it descended from the atmosphere. One of the properties of heat is that it is continually radiating to colder bodies, until an equilibrium of temperature is obtained, and it was to this radiation that Wells ascribed the formation of dew. He observed that it rarely or never appeared in clouded nights; and in proportion as the sky was clear and serene that it was formed in the greatest abundance: when he stretched even a thin handkerchief on pins at a slight elevation above the ground, the dew was deposited on the spot which was thus screened; this he accounted for from the supposition that its temperature never fell sufficiently low to condense the vapour above it, because that heat which was radiated from the earth to the handkerchief was not lost but radiated back again to the earth. Let this theory be carried out to its full extent and the clouds play the part of the handkerchief, acting like a pair of confrigate mirrors, they reflect back to the earth as much heat as they receive and thus preserve a balance of tempera-

ture; but on a clear starlight night when no clouds are present, the heat of the earth is radiated into empty space, and its surface being chilled, the watery vapour which surrounded it is condensed into dew. Dr. Prout, in his Bridgewater Treatise, says that "the influence of radiation in producing cold at the earth's surface, would scarcely be believed by inattentive observers. Often on a calm night, the temperature of a grass plot is 10 or 15 degrees less than that of the air a few feet above it."

If experimental evidence of the truth of this doctrine be required; let two different substances be exposed at night under the same circumstances, the one a sheet of polished metal, the other a flocculent porous mass of wool: when these are examined the latter will be found saturated with dew, while the former is free from moisture; the reason of this is that metals, though the best reflectors, are the worst radiators, and in proportion to their brightness; hence the surface of the polished metal never falls sufficiently low to condense the vapour, while the wool soon reaches the dew-point.

To return, however, to the more immediate subject of this paper, many individuals are in the habit of constructing what is called the *sponge* hygrometer, and for purposes not requiring accurate observation, this simple instrument answers every purpose: a thin rod of baked wood about twelve inches in length and suspended like a scale-beam, is made to work upon a pivot; to one end of this is fixed a sponga which is balanced by a weight at the opposite end; sponge like all organic substances is hygrometrical, consequently when the air is loaded with vapour, the sponge acquiring weight descends, and causing the rod to work upon a graduated scale, indicates the state of the atmosphere. The chief precautions to be attended to are, that it be kept in a situation where the temperature is equable; and that the scale be graduated by keeping in the apartment with the instrument certain deliquescent salts, such as the nitrates of lime or magnesia. It is advisable to prepare the sponge by washing it in a solution of sal-ammoniac. The hygrometer is generally a faithful indicator of the weather, sc far as it predicts the approach of rain; and indeed is an indispensable instrument in the hands of those who interest themselves in the study of meteorology.

W. PRESTON.

CUTTING GLASS TUBES, &c.

The different methods of cutting of glass tubes which have been contrived, are all founded on two principles; one of these is the division of the surface of glass by cutting instruments, the other the effecting of the same object by a sudden change of temperature; and sometimes these two principles are combined in one process.

The first method consists in notching the tube at the point where it is to be divided, with the edge of the file, or of a thin plate of hard steel, or with a diamond; after which you press upon the two ends of the tube, as if to enlarge the notch, or what is better, you give the tube a slight smart blow This method is sufficient for the breaking of small tubes. Many persons habitually employ an agate, or a common flint, which they hold in one hand, while with the other they rub the tube over the sharp edge of the stone, taking the precaution of securing the tube by the help of the thumb. For tubes of a greater diameter, you can employ a fine iron wire stretched in a bow, or, still better, the glass-cutters, wheel; with either of these, assisted by a mixture of emery and water, you can cut a circular trace round a large tube, and then divide it with ease.

When the portion which is to be removed from a tube is so small that you cannot easily lay hold of it, you cut a notch with a file, and expose the notch to the point of a candle flame: the cut then flies round the tube.

This brings us to the second method of cutting tubes—a method which has been modified in a great variety of ways. It is founded on the property possessed by vitrified matters of breaking when exposed to a sudden change of temperature. Make use of a piece of iron heated to redness, an angle or corner of which is to be applied to the tube at the point where it is to be cut, and then, if the fracture is not at once effected by the action of the hot iron, plunge the tube suddenly into cold water. The two methods here described can be combined. After having made a notch with a file, or the edge of a flint, you introduce into it a little water, and bring close upon it the point of a very little tube previously heated to the melting point. This double application of heat and moisture obliges the notch to fly right round the tube.

When the object to be cut has a large diameter and very thin sides—when it is such a vessel as a drinking-glass, a cup, or a gas tube—you may divide it with much neatness by proceeding as follows:—After having well cleaned the vessel, both within and without, pour oil into it till it rises to the point, or very nearly to the point, where you desire to cut it. Place the vessel, so prepared, in an airy situation; then take a rod of iron, of about an inch in diameter; make the extremity brightly red-hot and plunge it into the vessel until the extremity of the iron is half an inch below the surface of the oil: there is immediately formed a great quantity of very hot oil, which assembles in a thin stratum at the surface of the cold oil, and forms a circular crack where it touches the sides of the glass. If you take care to place the object in a horizontal position, and to plunge the hot iron without communicating much agitation to the oil, the parts so separated will be as neat and as uniform as you could desire them to be. By means of this method we have always perfectly succeeded in cutting very regular zones from ordinary glass.

The method which is described in some works, of cutting a tube by twisting round it a thread saturated with oil of turpentine, and then inflaming the thread, we have found to be unfit for objects which have thick sides.

Some persons employ rotten wicks dipped in sulphur. By the burning of these, the glass is strongly heated in a given line, or very narrow space, which is instantly cooled by a wet feather or a wet stick. So soon as a crack is produced, it can be led in any required direction by a red-hot iron, or an inflamed piece of charcoal.

Finally, you may cut small portions from glass tubes in a state of fusion, by means of common scissars.

CHEMICAL NOMENCLATURE.

There is of necessity a nomenclature in every science; and chemistry has its peculiar terms as well as other departments of knowledge; though we believe that its principles may be acquired without any extraordinary expenditure of mental exertion.

In tha construction of the language of modern chemistry, tha terms employed happily express the materials of which bodies are composed; and, being thus descriptive, they become opposite and appropriate. Were the nomenclature of this scienca the exclusive property of any peopla or country, it would be a "sealed fountain" to all else beside; but since chemistry is the birthright of all, her legend must be formed of plastic materials obtained from a common source, that all may read the history of her wonders. The terms of the modern nomenclature are thereforo obtained from that language which is venerable for antiquity—the vehicle of classic song, and which has ever formed an essential part of the scholastic studies of Europe. Significant epithets are employed, having their root in this spring of universal recognition, and are selected as descriptive of the forms and characters of chemical research.

A proper estimate of the superior valua of the new nomenclature may be best obtained by comparison, contrasting the new and old in juxta position; and, we much mistake, if, while it throws the old terms into the back ground and the shade, it does not bespeak a ready acquiescence in favor of the new nomenclature. In this estimate and contract, omplification would be useless and uncalled for; the selection may therefore be limited, and yet supply an ample specimen. Oil of tartar, oil of vitriol, butter of antimony, horn silver, sugar of lead, and cream of tartar, are terms altogether void of meaning and "signify nothing." Is *sugar* of lead said to be descriptive of its peculiar sweetness? So are also the salts of ittria and glucina in a still higher degree. Oil of vitriol and oil of tartar mislead by the adjunct *oil*, as the chemical constituents of oil are entirely absent. In the term *copperas* we might consider copper to be present, and naturally enough expect to find *lead* in "black lead;" yet the former is a sulphate of iron, and the latter a compound of iron and carbon. Nor is this the worst of these antiquated and unmeaning epithets, for the unwary would little suspect a *fatal poison* under the gifted name of 'acid of sugar."

When we turn to the new nomenclature, a more welcome languaga presents itself; though it cannot be reasonably expected that we are abla to apply terms critically descriptive of some invariable feature, to *all* the principles and elements of chemical research. Could this indeed be effected, the structure erected would be a durable monument of skill; it would ba stamped with a permanence which nothing could by possibility destroy, and which the novelties of discovery could never efface. Chlorine and iodina are examples of this description—these namea are full of meaning, and tha features on which they are founded can nevar change. Chlorine as chlorine, whether simple as now considered, or hereafter proved to ba compound, can never ceasa to ba presanted in a *green* attire; and iodine in tha state of vapour will ever assume a *violet* color. Chlorina is derived from a Greek word signifying *green*; and iodine from a root implying *violet*. So far these names, therefore, are expressive and appropriate.

Oxygen is a species of elastic air or gas; we do not, however, say that tha name conferred on it is critically correct, because it has no right to an exclusive monopoly of the term, which presumes it to be the acidifying principle; for though it ba often connected with the production of acid forms, wa find that there are acids, into tha constitution of which oxygen does not enter; such as hydro-sulphuric, hydro-chloric, hydro-cyanic, hydro-iodic, and hydro-bromic acids. Indeed, there are examples wharein tha base may form acids as well with hydrogen as with oxygen, as sulphur, iodine, &c. If sulphur be burnt in oxygen, sulphurous acid gas will be the product; but if potassium be heated in this gas the oxygen will ba abstracted from it, and trensferred to the potassium, giving risa to the alkali called caustic potassa; so that the combination of the ona base with oxygen forms an acid, and the other base, similarly combined, an alkali. Oxygen, however, in combination with metals, in minor proportionals, forms compounds, known under the general nama of *oxydes;* as oxyde of tin, or oxyde of iron; but as these proportionals are fixed and definite in quantity, the prefix *pro* (or proto,) or the prefix *per*, ara conjoined to denote tha lesser or greater weight or measure of tha combined oxygen. These are tha extremes, and the intermediate spaca, or links, between them, are described by the Greek numerals *deuto*, *trito*, &c., such as the deutoxyde of lead, or lead combined with two determinate proportionals of oxygen; and tritoxyde of manganese, or manganese is chemical combination with three measures of oxygen. Sometimes the *Latin* numerals are used, as illustrated in the next paragraph.

When sulphur combines with oxygen to form an acid, having distinct and specific powers of acidity, that acid will have its title or distinction conformable with tha amount or degree of acidification, and a simple change in the term will announce its nature. Hence sulphur-*ous* and sulphu-*ric* acids, the former being tha weaker degree of acidity, and the latter the greater acidity; while the occasional use of the prefix *hypo* implies a still inferior proportional of oxygen, and of necessity an inferior acidity. Thus *hypo*-sulphurous acid is a compound of 100 vapour of sulphur and 25 of oxygen, while sulphurous acid is composed of 100 sulphur and 100 oxygen. *Hypo*-sulphuric acid consists of 100 sulphur and 125 oxygen; and sulphuric acid 100 sulphur and 150 oxygen. Combinations of the former with alkalis, earths, or metallic bases, would be hyposulph-*ites* or sulph-*ites*, as hyposulphate of potassa; sulphite of lime, and sulphite of iron. In tha latter case, we have hyposulph-*ates* or sulph-*ates*, as hyposulphate of magnesia, and sulphate of manganese; while deuto-sulphate of manganese points out the combination of sulphuric acid; with the deutoxyde of that metal. When hydrogen is concerned in the acid changa which supervenes, *hydro* is the opposite prefix, as hydrocyanic acid; as *oxy* is, in cases where oxygen is connected—thus oxyiodic acid. Measures of the combined acid have in like manner distinctive prefixes as descriptive of quantity. Carbonate or chromate is descriptiva of the neutral salt; *bi*carbonate of magnasia, and *bi*chromate of potassa yield us the specific information that the former is composed of two proportionals of carbonic acid, united with the earth called magnesia, and the latter, two of chromic acid, combined with potassa. We hava also *bin*oxalate, *tetra*oxalate and *pent*oxalate of potassa, or potassa combined with two, four, and five proportionals of oxalic acid. *Hydrate* is a term applied to express the combination of *water* with a metallic oxyde; hence we say hydrate of lime, and hydrate of copper. It is substituted for the word *hydro-oxyde*. An *anhydrous* salt

implies the absence of water of crystallization or composition. Combinations of carbon, sulphur, phosphorus, &c., not being acidified, are termed carb*urets*, sulpho*rets*, or phosph*urets*, in general terms, or specifically, proto-sulphurets, per-carburets, &c.

In some instances *triple salts* are formed. In this case the term applied must express the combination; and as one of these *may* act in concert with the acid, and not form a *double base*, we say soda-moriate of gold; soda-muriate of rhodium; ammonia-sulphate of potassa; baryta-sulphate of platinum; ferro-cyonate of potassa: potassa-sulphate of nickel; and so on. In the salts of the earth, called *glucina*, there is a *sulphate* and a *sesquisulphate*. The latter prefix denotes an added proportional of base; thus, the *sesqui*sulphate of glucina consists of 100 proportionals of sulphuric acid and 98.4 of glucina, whereas the sulphate is composed of 100 of acid and 64.1 of base.

This brief description must speak powerfully in favor of the new language of chemistry, of which a few examples, however imperfectly explained, or limited in number, afford ample proof that, in reference to expressive simplicity and usefulness, there can be no just comparison between the new and the old nomenclature.

Note.—The list of the old and new names of chemical substances will appear in an early Number.

MISCELLANIES.

Receipt for Megilph. — Take eight ounces of sugar of lead, and eight ounces of rotten-stone; grind them together as stiffly as possible in linseed oil; then take sixteen ounces of white wax, and melt it gradually in an earthen pipkin, and when it is fluid, pour in eight ounces of spirits of turpentine; mix this well with the wax, and then pour the contents of the pipkin on the grinding stone to get cold; when cold, grind the rotten-stone and sugar of lead with the wax and turpentine, and it will form an excellent megilph, which will keep for years: if too hard for use at any time, add to it, as wanted, a little linseed oil.

Easy Method of taking a perfect Copy from a Print or Drawing.—Take a piece of clean lanthorn-horn; lay it upon the print or picture you wish to take off; then with a crow-quill, dipped in Indian ink, draw every stroke of the outline upon the horn; when dry, breathe upon that side of the horn whereon you have made your draft three or four times, and clap it directly on a damp piece of clean white paper, with the drawn side downwards; then, pressing it hard with the palm of your hand, the drawing will stick to your paper, and the horn come off clean.

This method is commonly practised by artists, and especially engravers, with a fine kind of hard and glassy paper, called horn paper, which is to be bought at an artist's colorman's in Oxford Street. The engravers scratch every line which is visible through the paper, and then rub red lead or red ochre over the whole; when reversed, it leaves the color on the ground laid on the copper plate beneath, in the finest possible lines—infinitely finer indeed than the lines made by the pen, especially as these spread by the pressure used in transferring.

To Clean Marble, Jasper, Porphyry, &c.—Mix up a quantity of the strongest soap lye with quick lime, to the consistence of milk, and lay it on the stone, &c., for twenty-four hours, clean it afterwards, and it will appear as new.

This may be improved by rubbing or polishing it afterwards with fine putty powder and olive oil.

To Clean Pictures.—Having taken the picture out of its frame, take a clean towel, and, making it quite wet, lay it on the face of your picture, sprinkling it from time to time with clear soft water; let it remain wet for two or three days: take the cloth off and renew it with a fresh one; after wiping your picture with a clean wet sponge, repeat the process till you find all the dirt soaked out of your picture; then wash it well with a soft sponge, and let it get quite dry: rub it with some clear nut or linseed oil, and it will look as well as when fresh done.

Weight of Steam.—Steam is 1800 times lighter than water—that is, a given portion of water will, in the form of steam, occupy 1800 times the space it did before.

To make an Image that shall always stand upright in a Glass Globe full of Water.—Make the lower part of the image of a man of wax, and the upper part of wood; then paint the figure all over with oil colors, and put it in a suspended glass globe. After the figure is put in, then, whichever way the globe is turned, the image will stand upright in the middle.

Native Country of Maize.—Roulin, Humboldt, and Bonpland, have noticed this plant in its native state, in America, and have hence concluded that it was originally derived from that country. Michaud, Daru, Gregory, and Bonafous state, that it was known in Asia Minor before the discovery of America. Crawford, in his History of the Indian Archipelago, tells us, that maize was cultivated by the inhabitants of these islands, under the name of *djagoung*, before the discovery of America. In the Natural History of China, composed by Li-Chi Tchin, towards the middle of the sixteenth century, an exact figure is given of maize, under the title of *la-chou-cha;* and Rifaud, in his "Voyage en Egypte, &c., from 1805 to 1807," discovered this grain in a subterraneous excavation in a state of a remarkably good preservation. M. Virey, however, refutes these statements, by showing, that these authors have mistaken the *holcus sorghum* for maize, and that the maize of Rifaud is the *holcus bicolor*, a native of Egypt, according to Delile. Where maize occurs in the East, there is no proof of its having been carried there previously to the discovery of America.

QUERIES.

125—What is Mr. Roberts's process for preserving animal bodies?—*Answered on page* 312.

126—Would an electrical machine made with a resinous plate, instead of one of glass, be effective?—*Answered on page* 27.

127—Requested, the result of any experiments upon the effect of medicated earths, or the coloration of flowers?—*Answered on page* 413.

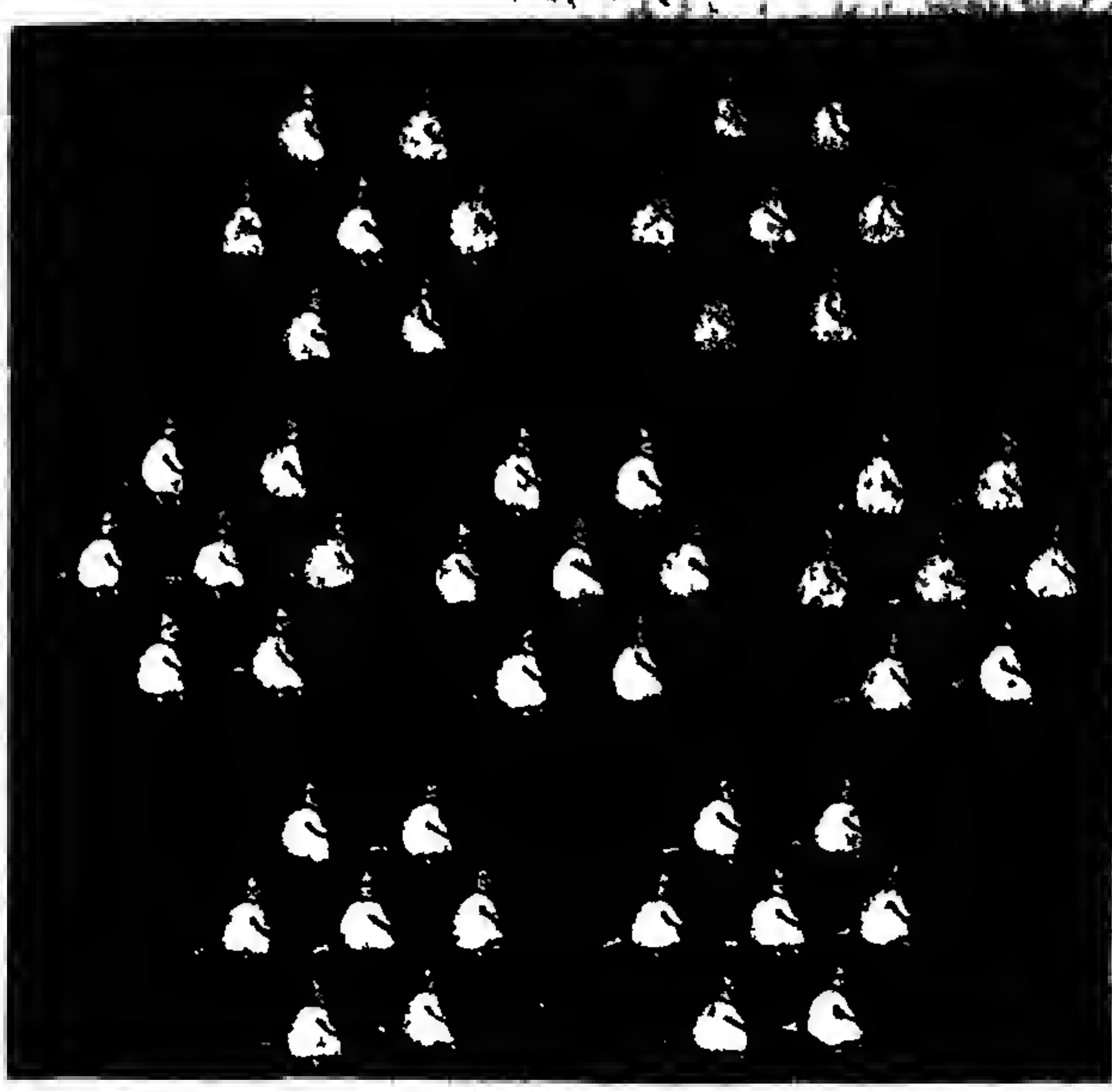
128—Is it possible to produce a blue dahlia, or a scented dahlia, and if so, what chance is there of its color, or scent, remaining permanent?—*Answered on page* 413.

129—How is horn to be dissolved, or reduced to a gelatinous substance?—*Answered on page* 271.

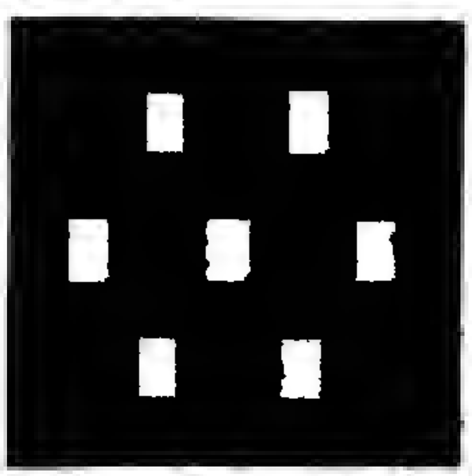
130—How is the multiplication of the figures in the magic lanthorn produced?—Does not our correspondent allude to an exhibition called the dance of witches? If so, the magic lanthorn is not used at all. We believe the secret is wholly confined to four or five persons: it shall be inserted in our next Number.

131—What is the preparation of sympathetic inks?—*Answered on page* 244.

Fig. 1.



THE DANCE OF WITCHES.



2.

3.

4.

THE DANCE OF WITCHES.

Of all the optical deceptions which have formed the subject of public exhibition, no one, with, perhaps, the exception of the phantasmagorea, has occasioned more amusement and astonishment, than that once shown by Mr. Henry, at the Adelphi Theatre; and afterwards by a Mr. Schmidt, at Leicester Square, called "*The Dance of Witches*," or "*The Dance of Monkeys*," according as one or other of these was made the subject of the pictures. The manner in which the delusion was caused, was a complete puzzle, and to this day has never been explained, if guessed at, and the principle known to be one object illuminated by several lights, and thus multiplied—still the imitation of all the effects seen failed when attempted to be practised by others.

The following is a plain description of the whole very simple apparatus, and manner of working it, which we give the more readily knowing it to be exact and true, and believing that there are a very few persons in the whole kingdom who can perform it, though it is an exhibition in the highest degree amusing, and may readily be shown in a private apartment, especially where folding doors open from one room into another.

Provide a medium, or screen, made of tissue paper—it should be the size of the room, and hung up in the same manner as the curtain of a theatre, so that the operator may have a space of six or eight feet on one side of it, and the audience on the other. If not made of the size of the room, it should be surrounded on all sides with some sheeting, or something similar, to prevent any one from looking behind it; it should, however, be six feet at least in diameter; and if for public exhibition at least double this. On the operator's side of this screen hang up the witch curtain, previously made thus:—Get a piece of thick canvas of the requisite size of the room, and paint it black on both sides, or else cover it with thick brown paper, so that no light can penetrate it in any part: then cut out in the centre of it seven holes, (as represented in figure 2,) and cover these holes with the figures of witches, cut out on pasteboard, (as seen in figure 3;) the bars, or bands, being left to strengthen the figure, as well as to give a little shape to the outline. Now fasten to each figure a flap, or cover, of pasteboard, larger than the figure itself. It must be fixed to the curtain by a hinge of rag, at the bottom of the hole it is intended to cover. These flaps must be fastened up by a single pin at the top, so that when pulled out suddenly the flap shall fall down, and discover the figure beneath. A side section of the medium and curtain is seen in figure 4, where one of the flaps is apparently falling. Next prepare two sticks, and a cross with a short handle to it, (as represented in figure 5,) with holes in them to contain some thick

Fig. 5.

wax tapers, made thus:—Take a taper as sold at the shops, unfold it, cut it into six equal lengths, and twist them together, with a bit of common candle wick cotton in the middle of them, cut it into pieces about two or three inches long, of which there should be fifteen in number; five for the cross—six for the two sticks—and four to be held in the hand. All that is requisite is now ready, except that the tapers may light easily when wanted, they may be burnt for a minute, and the tips then touched with spirits of turpentine.

To manage the exhibition, and for which an assistant is requisite, proceed as follows:—Light four of the tapers, which hold together in the hand—direct the assistant to loosen the centre flap, which falling down suffers the light to shine through the picture of the witch upon the front screen, but no where else. One witch will only be seen upon it. Give your assistant two of these candles, and there being now two lights, two witches will be seen. Let each of you take one in each hand, and four witches will be seen. As the hands are moved about so will the figures: and let it be observed, that it is always necessary that the assistant should exactly imitate his master in the motion of his hands, &c. Then the sticks being within reach, take one of them, and light the three candles upon it, being careful to blow out your own candles as the others are lighted. You will thus have three candles, your assistant two—therefore five witches will be seen. The other person lighting those on his stick six witches are visible. Hold both sticks in your own hand, horizontally above your head, so that the candles are equally distant from each other—turn yourself round, holding the candles quite still relatively to each other, and the six witches will appear to march around a centre. While this is doing the assistant should get ready to light the candles on the cross: these being lighted rapidly, and the others extinguished, hold the cross horizontally, and a line of five witches will appear; hold it vertically, and a circle of them, with one in the centre, will be visible: turn the cross round, and so will the witches move. Let the assistant open alternately the various other flaps, and so many groups will start into view, all having the same motion, which may be infinitely varied by the motion given to the cross; and if a second cross be used at the same time, the apparent confusion will be indescribable and highly amusing.

The figure 1 represents seven groups, made by a cross of six arms. The dimensions of the various parts are as follows;—Distance between the medium and witch curtain is 2 feet 7 inches. The centre figure is 5 feet from the ground—the figures about two feet from each other, and about 1 foot high. The sticks 4 feet 11 inches each, and the arms of the cross 2 feet from the centre outwards. These lengths were taken from Mr. Henry's orignal apparatus, but for private view much smaller dimensions may be adopted. By substituting paintings on glass for the pasteboard figures, color and greater delicacy is acquired. Also, the magic lanthorn may be combined with it with effect; suppose the central figure to be that of a fiddler, shown by the magic lanthorn, and only moveable as to its arms, and around it several groups of dancing dogs or monkeys, made with the cross, and the effect would be much enhanced. The figures themselves also might easily be made to move by means of strings.

CARMINE.

Carmine is, according to Pelletier and Caventon, a tripla compound of the coloring substance, and an animal matter contained in cochineal, combined with en acid edded to effect the precipitation. Tha preparation of this article is still e mystery, because npon the one hand, its consumption being very limited, few persons are engaged in its mannfacture, and upon the other, tha raw material heing costly, extensive experiments on it cannot be conveniently made. Success in this business is said to depend not a little upon dexterity of manipulation, and npon knowing tha instant for arresting the further action of heat upon tha materials.

There is sold at tha shops different kinds of carmina, distinguished by numbers, end possessed of a corresponding value. This difference depends upon two causes, either upon the proportion of alumnis added in the precipitation, or of a certain quantity of vermillion put in to dilute the color. In the first case the shade is paler, in the second, it has not the same lustre. It is always easy to discover the proportion of the adulteration. By evading ourselves of the property of pure carmine to dissolve in water of ammonia, the whole foreign matter remains untouched, and we may estimate its amount by drying the residuum.

To make Ordinary Carmine.

Take 1 pound of cochineal in powder;
3 drachms and a half of carbonate of potash;
8 drachms of alum in powder;
3 drachms and a half of fish glne.

The cochineal must be boiled along with the potash in a copper containing five pailfuls of water (60 pints;) the ebullition heing allayed with cold water. After boiling a few minutes the copper must be taken from the fire, and placed on a table at such an angle as that the liquor may be conveniently poured off. The pounded alnm is then thrown in, and the decoction is stirred, it changes color immediately, and inclines to a more brilliant tint. At the end of fifteen minutes the cochineal is deposited at tha bottom, and the bath becomes as clear as if it had heen filtered. It contains tha coloring matter, and probably a little alum in suspension. We decant it then into e copper of equal capacity, and place it over the fire, adding the fish-glue dissolved in a great deal of water, and passed through a sieve. At the moment of ebullition, the carmina is perceived to rise np to tha surface of tha bath, and a coagulum is formed, lika what takes place in clarifications with white of egg. The copper must be immediately taken from the fire, and its contents be stirred with a spatula. In the course of fifteen or twenty minutes the carmine is deposited. The supernatant liquor is decanted, and the deposit must be drained upon e filter of fine canvas or linen. If the operation has been well conducted the carmine when dry crushes readily under the fingers. What remains after the precipitation of the carmine is still much loaded with color, and may be employed very advantageously for carminated lakes.

By the old German process carmine is prepared by means of alum without any other addition. As soon as the water hoils the powdered cochineal is thrown into it, stirred well, and then boiled for six minutes; a little ground alnm is added, and the boiling is continued for three minutes more; the vessel is removed from the fire, tha liquor is filtered, and left for three days in porcelain vessels, in the course of which tima a red matter falls down, which must be separated and dried in tha shada. This is carmine, which is sometimes previously purified by washing. Tha liquor after three days more lets fall an inferior kind of carmine, hut tha residuary coloring matter may also be separated by muriate of tin.

The proportions for tha above process are 580 parts of clear river water, 16 parts of cochineal, and 1 part of alnm; there is obtained from $1\frac{1}{2}$ to 2 parts of carmine.

Anothar *Carmine with tartar.*—To tha boiling water the cochineal is added, and after some time a little cream of tartar; in eight minutes more we add a little alnm, and continue the boiling for a minute or two longer. Then take it from the fire, and pour it into glass or porcelain vessels, filter and let it repose quietly till the carmine falls down. We then decant and dry in the shade. The proportions are 8 pounds of water, 8 oz. of cochineal, $\frac{1}{2}$ oz. of cream of tartar, $\frac{3}{4}$ oz. of alum, and the product is an ounca of carmine.

Process of Madame Cenette of Amsterdam, with salt of sorrel.—Into six pails of river water, boiling hot, throw two pounds of the finest cochineal in powder, continue the ebullition for two hours, and then add 3 oz. of refined saltpetre, and after e few minutes 4 oz. of salt of sorrel. In ten minutes more take the copper from the fire, and let it settla for four hours; then draw off the liquor with a syphon into flat plates, and leave it there for three weeks. Afterwards there is formed upon the surface a pretty thick mouldiness, which is to be removed dexterously in one pelliole by a slip of whalebone. Should the film tear and fragments of it fall down, they must be removed with tha utmost care. Decant tha supernatant water with a syphon, tha end of which may touch the bottom of the vessel, because tha layer of carmine is very firm. Whatever water remains must be sucked away hy e glass tube. The carmine is dried in the shade, and has an extraordinary lustre.

Carmine by the salt of tin, or the Carmine of China.—Boil the cochineal in river water, adding some Roman alum, then pass through a fine cloth to remove the cochineal, and set tha liquor aside. It becomes brighter on keeping. After having heated this liquor, pour into it drop by drop a solution of tin till the carmine ba precipitated. Tha proportions are one pailful of water, 20 oz. of cochineal and 60 grains of alum, with a solution of tin containing 4 oz. of the metal.

To revive or brighten Carmine.—We may brighten ordinary carmine, and obtain a very fine and clear pigment, by dissolving it in water of ammonia. For this purpose we leave ammonia upon carmine in the heat of tha sun, till all its color he extracted, and the liquor has got a fine red tinge. It must then he drawn off and precipitated, by acetic acid and alcohol, next washed with alcohol, and dried. Carmine dissolved in ammonia has been long employed hy painters, under the name of liquid carmine.

Carmine is the finest red color which the painter possesses. It is principally employed in miniature painting, water colors, and to tint artificial flowers, because it is more transparent than the other colors.

DISTILLATION.

(Resumed from page 207, and concluded.)

We have already, in the former papers upon this subject, described the apparatus and process of distillation. It remains now to analyze some of the products of the operation, particularly those which are called ardent spirits, such as brandy, hollands, *gin*, cordials, &c.; and we give the following remarks, as well as those which have preceded, as the result of practical experience; and, first, as to *spirits of wine, pure spirit*, or *alcohol*, which is the spirit produced by the vinous fermentation, purified from all oils, acids, smoky flavor, and water, with which it is at first contaminated and weakened. To obtain it absolutely pure, it must, after being distilled as highly as possible, have put into it red hot potass, or muriate of lime, which absorbs the remaining water, leaving the spirit pure. To be used, however, for ordinary purposes, it is never required as strong as this. When raised to the highest possible strength, by means of distillation, it will still contain nearly a fourth part water. To test it, the distillers and publicans use an instrument, called an *hydrometer*, which enables them to tell accurately the real quantity of spirit contained in any mixture of spirit and water, though if sugar, oil, &c., be added, the hydrometer is baffled and useless. The greatest consumption of spirit of wine is by the publicans, for making such liquors as peppermint, noyeau, &c. By the hatters and varnish makers for the solution of copal and other gums. By the perfumers for essences; and by the chemists for tinctures. The usual popular way of trying the strength is to shake up a little in a phial—if the *bead*, or froth, subsides instantly, it may be presumed very strong, or otherwise, in proportion to this subsidence. It is customary also to cover a little gunpowder with some spirit, set fire to the latter, and if it wholly burns away without firing the gunpowder the spirit is weak; if it fires the powder, it is known to be of adequate strength.

Brandy, French and British. In the process of the wine manufacture in France, Spain, &c., the whole of the grapes, sometimes stalks and all, are boiled, strained, and pressed. The juice fermented becomes wine—the skins, &c., left on the strainer are also suffered to ferment, and being distilled form brandy. This is re-distilled only once more, and then comes to us as an article of consumption, of considerable strength, and still loaded with the peculiar flavor of the grape. It is, as all liquors passing from the still are, colorless, like water, the brown tint being afterwards given to it by burnt sugar. Not having the above means we never can make in this country brandy equal to that of France, and the law interferes to prevent the application of those resources which are partially open to us. We might, were it not for this, ferment the dried grapes which are imported, and thus add to our malt spirit a partial brandy flavor—but this the excise prevents. The British brandy flavor is at present given by orris root and sweet spirits of nitre.

Rum, Arrack, and *Hollands.*—Remarks analogous to the above will apply to these and some other spirits. For some of them we have not the materials—others we are not allowed to manufacture by the only means which can be successful. For rum, the sugar canes are first crushed, then boiled, and partially refined and crystallized. The refuse of the bruised canes, the impurities of the sugar, and the sweepings of the sugar houses, mixed with water, soon ferment. The liquid taken up into the still worked off, and afterwards again distilled, yields rum. A process, similar to that of the English malt distiller, using rice as a staple, produces arrack. Adding juniper berries, in requisite quantity, to grain, fermenting them together, and distilling more or less in the manner of making hollands. Here we cannot ferment them together, and are obliged to be content with gin.

And what is *gin?* Morally, it is that which builds up public-houses like palaces; and which pulls down the comfortable home of the English labourer to a den of squalidness and want—which fills our courts with misery, and our streets with vice: it is that which debilitates the constitution of body and of mind, and which yearly dooms thousands of the inhabitants of this island to disease and premature death. Politically, it is that which yields a revenue of nearly three millions pounds per year—which extends in quantity to almost eight million gallons—which, if it were formed into a canal, 10 feet wide and 5 feet deep, would reach no less than five miles. If put into casks of the usual size, (120 gallons,) end shape, and these placed end to end in a line, that line would extend 600 miles, and were it possible to place it into twenty casks, each of these would be of the height of St. Paul's Cathedral. Scientifically speaking, gin is merely a compound of spirit and water, flavored by juniper berries, coriander seed, orange peel, and angelica root, and sweetened afterwards by sugar. A compound such as this is wholesome, if not beneficial, and could gin be procured thus from the publicans by the lower orders of people, its moderate use could scarcely be objected to on the score of health; but it cannot and is not to be had thus. We could give an account of admixtures almost incredible—of gin made without any one of the above materials except, indeed, sugar and water. One ingredient is added to communicate a fictitious strength, and this is sometimes cayenne pepper; but more frequently another, and infinitely more injurious ingredient, an insect poison of deadly malignity. Another poison is added to increase flavor, and as if this were not enough, a third equally deleterious liquid is added, expressly for the purpose of exciting thirst, that the regular gin drinker may require a second potion almost as soon as he has swallowed the first. This we know to be true, strange as it may seem, and would give the whole secrets, but are fearful that such might induce further adulteration rather than repress that which at present exists.

Cordials.—Little remains to be said on these liquids. They are made without distillation, except that pure spirit forms part of their composition.

Noyeau is made by boiling bitter almonds, or almond cake, (this is the cake left after almond oil has been extracted from the nuts: it is imported for this purpose, and also much used by pastry-cooks, &c., it having the same flavor as almonds, and being cheaper,) in water, adding a little spirit, and plenty of loaf sugar to it afterwards.

Usquebaugh is a celebrated cordial, made of many flavoring ingredients, added to spirit. To make it, take of nutmegs, cloves and cinnamon, each one ounce—the seeds of anise, carraway, and coriander, each two ounces—liquorice root, four ounces, and bitter almonds, two ounces: bruise all these, pour upon them one gallon and a half of strong spirit—

after soaking two days, pour it off clear, and add sugar and water.

Ratifia, Rosiglon, Marasquin, Cherry and Rasp berry Brandy, &c. &c., are made from the juice of fruits preserved in brandy, and flavored with sugar, and occasionally spices. Also, the cordials, called *Peppermint, Cloves, Anniseed, Cinnamon, Carraway, Lovage, &c. &c.*, as well as the sweet essences of rose, lavender, &c., are merely a clean and pure spirit, impregnated with the flavoring oil, or they may any of them be made by distilling the spices, seeds, flowers, &c., with spirit, which brings out the essential oil. If made by mere mixture about one ounce of oil is allowed to ten gallons of spirit for a cordial, but there should be nearly ten times this for strong and fine lavender water.

CAUSES OF THE SURF AND SWELLING OF THE SEA.

The surf or swell and breaking of the sea, sometimes forms but a single range along the shore and at others three or four behind one another, extending perhaps half a mile out to sea. The surf begins to assume its form at some distance from the place where it breaks, gradually accumulating as it moves forward, till it attains, not uncommonly, in places within the limits of the trade-winds, a height of fifteen or twenty feet, when it overhangs at top, and falls like a cascade with great force and a prodigious noise. Countries where surfs prevail require boats of a particular construction very different from the greater part of those which are built in Europe. In some places surfs are great at high, and in others at low water; but we believe they are uniformly most violent during the spring-tides.

It is not easy to assign the cause of surfs. That they are affected by the winds can hardly be questioned; but that they do not proceed from the immediate operation of the wind in the place where they happen, is evident from this circumstance, that the surf is often highest and most violent where there is least wind, and *vice versa.* On the coast of Sumatra the highest are experienced during the south-east monsoon, which is never attended with such gales as the north-west. As they are most general in the tropical latitudes, Mr. Marsden, who seems to have paid much attention to the subject, attributes them to the trade-winds which prevail at a distance from shore between the parallels of thirty degrees north and south, whose uniform and invariable action causes a long and constant swell, that exists even in the calmest weather, about the line, towards which its direction tends from either side. This swell, when a squall happens or the wind freshens up, will for the time have other subsidiary waves on the extent of its surface, breaking often in a direction contrary, and which will again subside as a calm returns, without having produced on it any perceptible effect. Sumatra, though not continually exposed to the south-east trade-wind, is not so distant but that its influence may be presumed to extend to it; and accordingly at Poole Presang, near the southern extremity of the island, a constant southerly sea is observed, even after a strong north-west wind. This incessant and powerful swell rolling in from an ocean, open even to the pole, seems an agent adequate to the prodigious effects produced on the coast; whilst its very size contributes to its being overlooked. It reconciles almost all the difficulties which the phenomena seems to present, and in particular it accounts for the decrease of the surf during the north-west monsoon, the local wind then counteracting the operation of the general one; and it is corroborated by an observation, that the surfs on the Sumatran coast ever begin to break at their southern extreme, the motion of the swell not being perpendicular to the direction of the shore. This explanation of the phenomena is certainly plausible; but as the author candidly acknowledges objections may be urged to it. The trade-winds and the swell occasioned by them are remarkably steady and uniform; but the surfs are much the reverse. How then comes a uniform cause to produce unsteady effects?

In the opinion of Mr. Marsden, it produces no unsteady effects. The irregularity of the surfs, he says, is perceived only within the remoter limits of the trade-winds. But the equatorial parts of the earth performing their diurnal revolution with greater velocity than the rest, a larger circle being described in the same time, the waters thereabout, from the stronger centrifugal force, may be supposed more buoyant; to feel less restraint from the sluggish principle of matter; to have less gravity; and therefore to be more obedient to external impulses of every kind whether from the winds or any other cause.

FANCY WOODS.

Even at a comparatively early stage of the arts, mankind appear to have made use of the bright or variegated colors of wood, to give beauty both to their dwellings and their furniture. The temple built by King Solomon was overlaid on the inside with boards of cedar:—"All was cedar; there was no stone seen;" and among the most ancient specimens of ornamental furniture that are to be met with, we find that attempts have been made to heighten the effect by the contrast of various kinds of wood. Although, both in the materials and the designs, these are inferior to the productions of modern art, many of the cabinets which are still preserved have much higher claims to notice than their mere antiquity.

In all these works a veneer or thin plate of the fancy wood is laid down in glue, upon a surface of a plainer description. This process is of course cheaper than if the whole work were made of the solid fancy wood. The beauty of fancy wood arises in many sorts from its being cross-grained, or presenting the fibres endways or obliquely to the surface. These different positions of the fibres, as well as their different colors in grained woods, give a clouded and mottled variety to the surface; and when some of the parts are partially transparent, as is the case with fine mahogany, the surface gives out a play of different tints, as the observer shifts his place, or the light falls upon them.

In the earlier stages of the art of cabinet making, and before the forests of the tropical regions had been explored for those beautiful woods which have since added so much to the elegance of modern furniture, the veneering and ornamenting were in woods of native growth. None of these have the deep and warm tints of the finest of the foreign; but the figures with which they are marked are often very beautiful. The yew, which, with its other tints, blends a certain trace of pink or rose-color, and when it is gnarled or knotty,

has a very rich appearance, was the wood used for the finest and most costly works. The common veneering timber was walnut; but as that has but few of those variegations, which are technically termed *curls*, the works ornamented with it were rather deficient in beauty. The knotty parts of "pollard" oaks, and "pollard" elms, are much better adapted for the purpose of ornament; but as the grain of both is open, and as it is apt to *rise*, and as the earlier cabinet-makers were not so well acquainted with the art of varnishing, as those of modern times, the beauties of these woods were not turned to the proper account.

When mahogany was first introduced as a cabinet timber, it seems to have been in the dark-colored, hard, and straight-grained trees, which are now used for chairs, and other articles, in which the solid timber is preferred; and on that account mahogany was not much used in combination with other woods. When, however, its great value was known — the ease with which it can be cut, the improvement that varnish gives to its colors, the firmness with which it holds in glue, and the improvement which, when properly taken care of, it gains in time—it was found that good mahogany was much too valuable a timber for being used solid; and it began to be employed as the staple timber in veneering. Other foreign woods, some of them lighter and others darker, were employed for borders and ornaments: but mahogany was used for the body of the work; and when it became to be so used, a great revolution was effected in the art of cabinet-making.

Mahogany is of universal use for furniture, from the common tables of a village inn to the splendid cabinets of a regal palace. But the general adoption of this wood renders a nice selection necessary for those articles which are costly and fashionable. The extensive manufacture of piano-fortes has much increased the demand for mahogany. This musical instrument, as made in England, is superior to that of any other part of Europe; and English piano-fortes are largely exported. The beauty of the case forms a point of great importance to the manufacturer. This circumstance adds nothing, of course, to the intrinsic value of the instrument; but it is of consequence to the maker, in giving an adventitious quality to the article in which he deals. Spanish mahogany is decidedly the most beautiful; but occasionally, yet not very often, the Honduras wood is of singular brilliancy; and it is then eagerly sought for, to be employed in the most expensive cabinet-work. A short time ago, Messrs. Broadwood, who have long been distinguished as makers of piano-fortes, gave the enormous sum of three thousand pounds for three logs of mahogany. These logs, the produce of one tree, were each about fifteen feet long and thirty-eight inches wide. They were cut into veneers of eight to an inch. The wood was peculiarly beautiful, capable of receiving the highest polish; reflecting the light in the most varied manner, like the surface of a crystal, and, from the wavy from of the fibres, offering a different figure in whatever direction it was viewed. A new species of mahogany has been lately introduced in cabinet-work, which is commonly called Gambia. As its name imports, it comes from Africa. It is of a beautiful color, but does not retain it so long as the Spanish and Honduras woods. One of the peculiar excellences which is sought for by cabinet-makers, consists in what they call the *curl*—the direction which the darker parts take in the grain of the wood. But the dealers, although they introduce an auger before they buy a log, are seldom enabled to determine, with much exactness, the quality of the timber. Although mahogany has been so long known in commerce, there is little correspondence between those who export the timber and those who purchase it in this country; and thus it is generally a matter of chance whether the manufacturer may purchase a fine or an inferior commodity. The logs which procured such a large price as Messrs. Broadwood gave for them, were particularly celebrated, and were brought to this country with a knowledge of their worth.

The wood most in use for cabinet-work, next to mahogany, is *Rose-wood*. The name of this species of wood is derived from its fragrance; and it has long been known to the cabinet-makers of England and France. It was first introduced, it is said, from the isle of Cyprus; though the great supply now comes from Brazil. The width of the logs imported into this country averages twenty-two inches, so that it must be the produce of a considerable tree. The wood is too well known to require any description. The more distinct the parts are from the purple-red, which forms the ground, the more is the wood esteemed. It is ordinarily cut into veneers of nine to an inch; and is employed in this way for all the larger furniture, such as tables; but solid for the legs of chairs, and cabinets.

(*Continued* on *page* 225.)

FOILS.

Foils are thin plates or leaves of metal that are put under stones, or compositions in imitation of stones, when they are set, either to increase the lustre and play of the stones, or more generally to improve the color, by giving an additional force to the tinge, whether it be natural or artificial, by a ground of the same hue with the foil.

There are two kinds of foils; one colorless, where the effect of giving lustre to the stone is produced by the polish of the surface, making it act as a mirror, and, by reflecting the light, prevents the deadness which attends a duller ground under the stone, and brings it nearer to the effect of the diamond. The other is colored with some pigment or stain, either of the same hue as the stone, or of some other, which is is intended to change the hue of the stone in some degree; thus a yellow foil may be under a green which is too much inclined to blue, or under crimson, where it is desired to have the appearance of orange or scarlet.

Foils may be made of copper or tin. Silver has been sometimes used, and even gold mixed with it; but the expense of either is needless, as copper may be made to answer the same end.

Copper intended for foils is prepared by taking copper plates beaten to a proper thickness, passing them betwixt a pair of fine steel rollers very close set, and drawing them as thin as possible. They are polished with very fine whiting, or rotten-stone, till they shine, and have as much brightness as can be given them, and they will then be fit to receive the color. If they are intended for a purple or crimson color, the foils should first be whitened in the following manner:—Take a small quantity of silver, and dissolve it in *aquafortis*, then put bits of copper into the solution, and

precipitate the silver; which being done, the fluid must he poured off, and fresh water added to it, to wash away the other fluid; after which the silver must be dried and equal weight of cream of tartar and common salt ground with it, till the whole is reduced to a very fine powder. With this mixture the foils, slightly moistened, must he rubbed by the finger, or a bit of linen rag, till they are of the degree of whiteness desired.

To color Foils.—The colors used for painting foils may be used with either oil, water rendered glutinous by gum-arabic, size, or varnish. Where deep colors are wanted, oil is most proper, because some pigments become wholly transparent in it, as lake, or Prussian blue; the yellow and green may be better laid on in varnish, as these colors may be had in perfection from a tinge wholly dissolved in spirit of wine, in the same manner as in the case of lacquers; and the most beautiful green is to be produced by distilled verdigris, which is apt to lose its color and turn black with oil. In common cases, however, any of the colors may be, with the least trouble, laid on with isinglass size, in the same manner as the glazing colors used in miniature painting.

Ruby Colors.—For red, where the ruby is to be imitated, a little lake in used in isinglass size, carmine, or shell-lac varnish, is to be employed, if the glass or paste be of a full crimson, verging towards the purple; but if the glass incline to the scarlet, or orange, very bright lake, not purple, may be used alone in oil.

Garnet Red.—For the garnet red, dragon's blood dissolved in seed-lac varnish may be used; and for the vinegar garnet, the orange lake, tempered with shell-lac varnish, will be found excellent.

Amethyst.—For the amethyst, lake, with a little Prussian blue, used with oil, and very thinly spread on the foil, will answer.

Blue.—For blue, where a deep color, or sapphire is wanted, Prussian blue not too deep should be used in oil, and be spread more or less thinly on the foil, according to the lightness or deepness of the color required.

Eagle Marine.—For the eagle marine, common verdigris, with a little Prussian blue, tempered in shell-lac varnish.

Yellow.—Where a full yellow is desired, the foil may be colored with a yellow lacquer, laid on as for other purposes. For light yellows, the copper ground of the foil itself, properly burnished, will be sufficient.

Green.—For green, where a deep hue is required, the crystals of verdigris, tempered in shell-lac varnish, should be used; but where the emerald is to be imitated, a little yellow lacquer should be added, to bring the color to a truer green, and less verging to the blue.

Other Colors.—The stones of more diluted color, such as the amethyst, topaz, vinegar-garnet, and eagle marine, may be very cheaply imitated by transparent white glass or paste, even without foils. This is to be done by tempering the colors above mentioned with turpentine and mastic, and painting the socket in which the counterfeit stone is to be set with the mixture, the socket and stone itself being previously heated. In this case, however, the stone should be immediately set, and the socket closed upon it before the mixture cools and grows hard. The orange lake, mentioned under the head of garnet red, was invented for this purpose, in which it has a beautiful effect, and has been used with great success. The color it produces is that of the vinegar-garnet, which it affords with great brightness.

The colors before directed to be used in oil should be extremely well ground in oil of turpentine, and tempered with old nut or poppy-oil; or, if time can be given for their drying, with strong fat oil, diluted with spirit of turpentine, which will gain a fine polish of itself. The colors used in varnish should be likewise thoroughly well ground and mixed; and in the case of the dragon's blood in the seed-lac varnish and the lacquer, the foils should be warmed before they are laid out. All the mixtures should be laid on the foils with a broad soft brush, which must be passed from one end to the other, and no part should be crossed, or twice gone over, or at least not till the first coat can be dry, when, if the color do not lie strong enough, a second coat may be given.

CASTING MEDALLIONS IN SULPHUR, &c.

(Resumed from page 214, and concluded.)

The process of making sulphur moulds and plaster casts, already described, will suggest the general directions to be given in making sulphur coins, medals, gems, &c. The moulds are to be made of plaster of Paris, cast from the original objects, or facsimilies of them. To make gems or sulphur seals is the most easy, and require no instruction beyond that given in page 191—except as to color. It is requisite, in order that they should be of a fine red, to mix with the sulphur a little of the best English vermillion, (Chinese vermillion turns black,) and to heat the sulphur as little as possible. In fact, to succeed perfectly, the sulphur should be just melted, then the vermillion mixed with it, and immediately used up; when cast, they may be trimmed around the edges with a pen-knife, and inclosed in a strip of filagree paper. They are infinitely sharper than impressions made with sealing wax, and will bear the heat of a direct summer's sun without injury. Seal engravers, therefore, who desire impressions of seals to display in their shop windows, have recourse to sulphur casts, rather than the more perishable ones of sealing wax. The late Mr. Tarsey, of Leicester Square, carried on a considerable trade in these apparently simple articles.

It is advisable in the imitation of monkish seals, Romish amulets, engraved inscriptions, and other similar objects, not to have them of a uniform red color, but bearing traces of the rude antiquity which distinguished the originals. This may be given by the most simple means, and with the greatest effect. They may be cast in ordinary sulphur when it is of that fawn or reddish grey color, which it acquires by melting once or twice. When cast and trimmed, rub over the whole of it a common hard brush, dipped in black lead—that brush used ordinarily by servants to polish stoves will do better than any other, as it is imbued with the lead powder. The quantity to be put on is according to fancy. It will be seen to adhere to the roughness and depressions, and bring the more prominent parts out in fine relief. If a gloss be desirable, rubbing the seal with a piece of wool or cotton will communicate it readily.

Coins and Medallions.—A difficulty arises when we endeavour to cast a coin of two engraved sides; and some persons have cast them by holding vertically at a little distance from each other, the two plaster moulds, surrounding them with a strip of

paper, so as to leave only a small hole at the top, pouring sulphur in this hole, and renewing it as it contracts in cooling by a drop or two more poured in. When cast thus, a mark will often be seen running across the face of the medal, especially when large. This spoils its beauty; and until lately, no means were known to remedy the defect. Others cast a very thin coat of sulphur on the mould of the one side, then another thin coat on the other mould; put these together and pour sulphur as before, between them. This method is, however, exceedingly tedious, as it is apt to make the coins much too thick, and what is even worse, unequally so. The best method is now found to be to cast both sides at once of common yellow sulphur, to cover them with black lead, as recommended for seals, &c. above, and afterwards to mark them over with a camel-hair brush, dipped in a weak tincture or solution of dragon's blood in spirits of wine, which communicates a very fine antique bronze color, capable of being considerably modified in tone by the admixture of any other transparent coloring material, such as lake, yellow lake, &c. Ancient seals look remarkably well if cast of a green color; which is done either by mixing a green pigment with the melted sulphur, or more transparently, by a slight varnish of spirits of wine and distilled verdigris, laid on in the same manner as the bronze color above described. It needs scarcely be said, that all these objects are exceedingly brittle, and will crack, not merely at a slight fall, but often with a very moderate degree of heat, such as that of the hand.

MISCELLANIES.

To Imitate Tortoiseshell with Horn.—Mix up an equal quantity of quick lime and red lead, with soap lees; lay it on the horn with a small brush, in imitation of the mottle of tortoise-shell; when it is dry, repeat it two or three times.

Or grind an ounce of litharge and half an ounce of quick lime, together with a sufficient quantity of liquid salt of tartar to make it of the consistence of paint. Put it on the horn with a brush, in imitation of tortoise-shell, and in three or four hours it will have produced the desired effect; it may then be washed off with clean water; if not deep enough, it may be repeated.

Or take a piece of lunar caustic about the size of a pea; grind it with water on a stone, and mix with it a sufficient portion of gum-arabic, to make it of a proper consistence; then apply it with a brush to the horn in imitation of the veins of tortoise-shell. A little red lead, or some other powder mixed with it, to give it a body, is of advantage. It will then stain the horn quite through without hurting its texture and quality. In this case, however, you must be careful, when the horn is sufficiently stained, to let it be soaked for some hours in plain water, previous to finishing and polishing it.

Razor Strop.—Accident, the love of experiment, or some higher cause, which contributes so largely to the comforts and conveniencies of mankind, has furnished us with a new recipe for a most effectual razor-strop, that with a very few strokes of the instrument thereon produces a very fine edge, capable of reducing the most obstinate beard to its required nothingness. Like all other useful discoveries, the process and applicability is obvious, cheap, and easily performed, and we are indebted for its free promulgation to the inventor, a Mr. Fawell. He spreads the well-known *blue pill* of the shops upon buff leather, smoothing it with the razor back, and it is fit for use in the ordinary way. The blue pill, in mass, may be bought at Apothecaries' Hall, and other druggists' shops.

Soap suds made strong, and rubbed over the hone or razor strop, is found to answer better than the usual dressing of sweet oil, and is much less expensive.

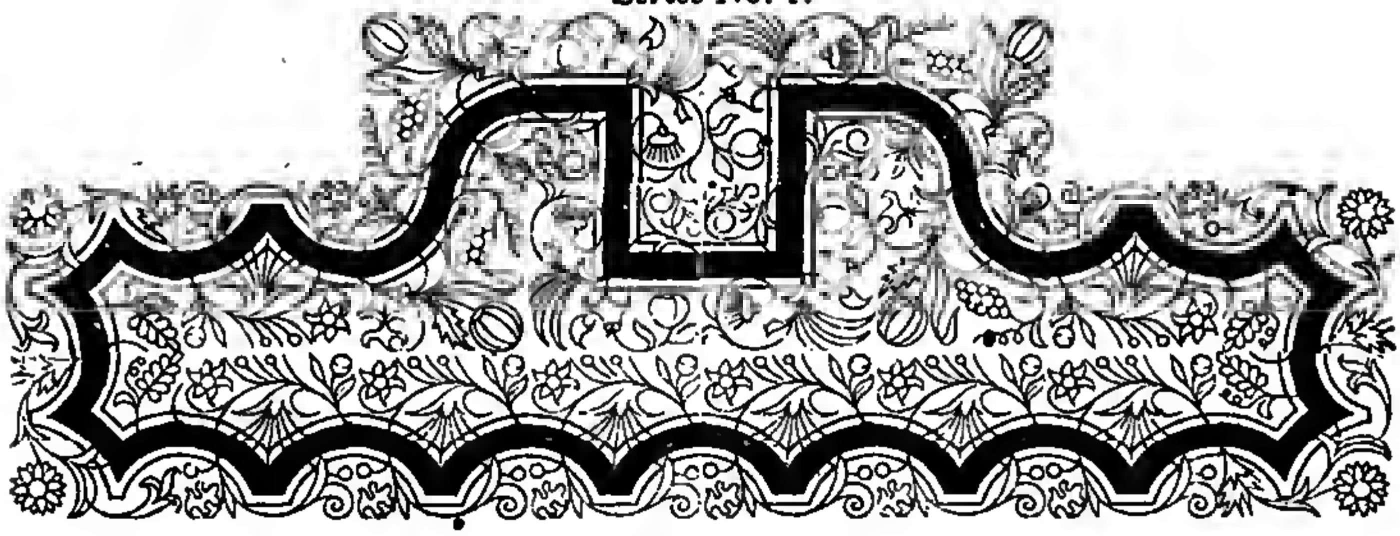
Alloy for the Specula of Telescopes.—Melt seven ounces of copper, and, when fused, add three ounces of zinc and four ounces of tin. These metals will combine to form a beautiful alloy of great lustre, and of a light yellow color, fitted to be made into specula for telescopes. Mr. Mudge used only copper and grain tin, in the proportion of two pounds to fourteen ounces and a half.

To procure Iodine.—Digest eight ounces of pulvarized kelp or sea-weed in a quart of water, and filter it through paper. Evaporate it by a gentle heat, in a Wedgewood's vessel; the muriate of soda will be formed into crystals at the bottom. Mix four ounces of sulphuric acid with the uncrystallized solution; and boil it for about five minutes: next, put this mixture into a tubulated retort with four ounces of the black oxide of manganese, and place the whole over a lamp; let a receiver be attached to it: the iodine will soon rise in the form of a violet-colored vapour, and be condensed on the sides of the receiver in dark shining speculæ, something like plumbago. Preserve it in a phial, having a ground stopper. Iodine was discovered in Paris by a saltpetre manufacturer, who observed a rapid corrosion of his metal, used in preparing different sorts of sea-weeds, which he used in making carbonate of soda.

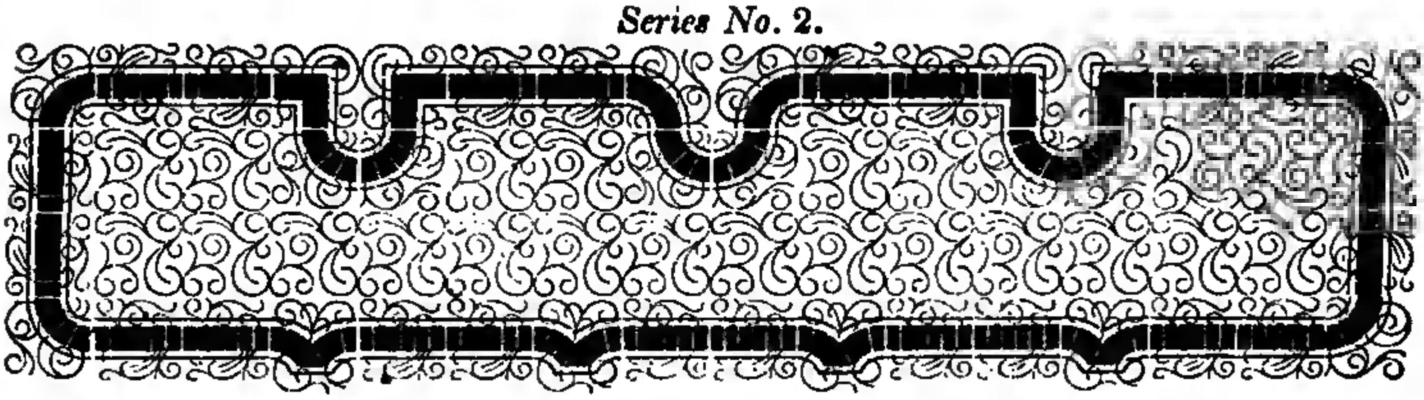
Etching Glass for Thermometers.—Coat the glass to be graduated, &c., with yellow wax, and trace with a steel point whatever is intended to be etched. Now dip the glass in sulphuric acid, and shake over it some fine pulverized fluate of lime, (fluor spar.) This salt will be decomposed by the affinity of lime for sulphuric acid. Accordingly, the fluoric acid will be set free to attack the silica of the glass. Corrosion of those parts which are uncovered by the wax will be the consequence.

To Purify Water for Domestic and other Purposes.—This method consists in placing horizontally, in the midst of a common water butt, a false bottom, perforated with a great number of little holes. The butt being thus divided into two equal parts, the upper is filled with pieces of charcoal, which must be neither too large nor too small, thoroughly burned, light, and well washed. Immediately under the cock, by which the water enters the butt, must be placed a small hollow cylinder, being merely to break the force of the water, and prevent it from falling upon the charcoal with such violence as to detach from it any particles of dirt, and wash them through into the lower receptacle; it is of little consequence of what material it is made. This contrivance might be made subservient to the interests of agriculture as well as domestic economy; and it would be highly advantageous to provide water thus filtered for the cattle during the whole of the dog days, and particularly when the ponds and streams are infected by the rotting of hemp and flax.

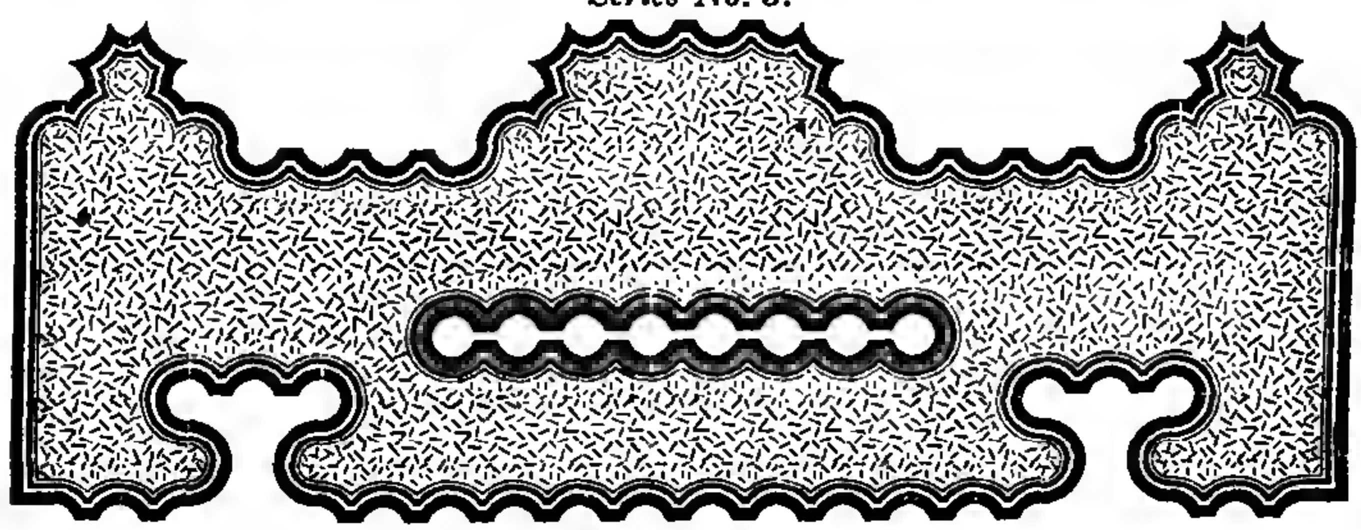
Series No. 1.



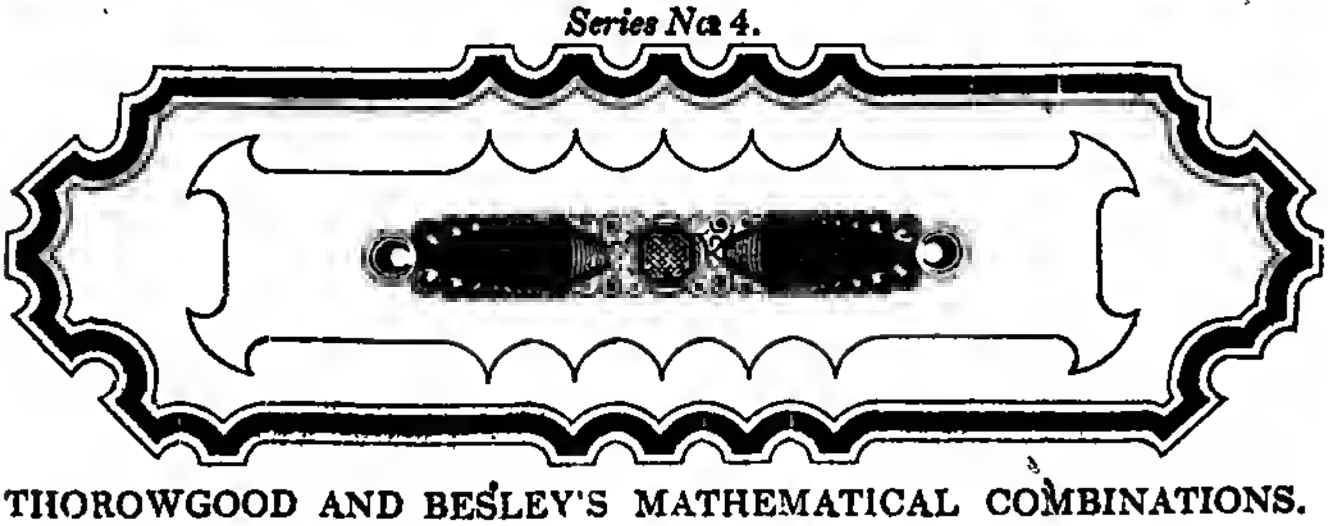
Series No. 2.



Series No. 3.



Series No. 4.



THOROWGOOD AND BESLEY'S MATHEMATICAL COMBINATIONS.

THOROWGOOD AND BESLEY'S MATHEMATICAL COMBINATIONS.

The annexed are part of a series of Mathematical Combinations of very chaste and elegant designs for letter-press ornaments, introduced by the eminent letter founders, Messrs. Thorowgood and Besley, of Fann Street, London. The designs are by a French artist, Mons. Dermez. From the great practical utility and the simplicity with which they may be thrown into such a variety of forms, these designs must, in a great measure, supersede every other description of ornamental border.

The general character of our typographical embellishments, as compared with our neighbours the French, have been miserably deficient in style and execution, and we hail the introduction of these combinations as a harbinger of the improving taste of the times.

The series No. 1, is formed of six blocks, or squares, with a bold dark line running exactly through the centre of the square, and upon as it were a delicate chasing of foliage; there are two squares with the junctions opposite each other in continuous lines, and four squares with the junctions at different angles, so that by the use of a square block, or quadrat, any size and almost any shape of border may be constructed, with little or no difficulty to the compositor.

Series No. 2 is also formed of six squares, but of an entirely different character; here the artist has introduced a square for the purpose of extending the breadth of the border; a more distinct idea may be formed by referring to the squares themselves.

Series No. 3 is again different, and is composed of nine squares, but with also a square to extend or form ground work; in this series there are two sets of angles to continue the double line without a break; these will be better understood by a careful examination of the parts, unconnected with each other.

Series No. 4, with a single line series in the inside, is formed upon the same principle as No. 2, but without flourishes of any sort; here the printer can have plain lines so constructed that he may turn them into a thousand endless varieties, without there appearing any formality or sameness with his work, and there is a strength and boldness with the design that gives them great effect.

AMATEUR GLASS BLOWING.

(Resumed from page 203.)

All the modifications of shape and size which can be given to tubes in the construction of various instruments, are produced by a very small number of dissimilar operations. The following are the chief of them, and the caution to be regarded in their manipulation—remembering that the cutting glass by various methods has been already described in page 230.

Bordering.—To whatever use you may destine the tubes which you cut, they ought, almost always, to be bordered. If you merely desire that the edges shall not be sharp, you can smoothen them with the file, or what is better, you can expose them to the flame of the lamp until they are rounded. If you fear the sinking in of the edges when they are in a softened state, you can hinder this by working in the interior of the tube a round rod of iron one-sixth of an inch thick: one end of it should be filed to a conical point, and the other end be inserted into a thin, round, wooden handle.

When you desire to make the edges of the tube project, bring the end to a soft state, then insert in it a metallic rod, and move it about in such a manner as to widen a little the opening. While the end of the tube is still soft, place it suddenly upon a horizontal surface, or press it by means of a very flat metallic plate. The object of this operation is to make the end of the tube flat and uniform. Very small tubes can be bordered by approaching their extremities to a flame not acted upon by the blowpipe; particularly the flame of a spirit-lamp.

When the edges of a tube are to be rendered incapable of suffering considerable pressure, you can very considerably augment their strength by soldering a rib or string of glass, all round the end of the tube. Holding the tube in the left hand, and the string of the glass in the right, you expose them both at once to the flame. When their extremities are sufficiently softened, you attach the end of the rib of glass to the tube at a very short distance from its extremity; you then continue gradually to turn the tube, so as to cause the rib of glass to adhere to it, in proportion as it becomes softened. When the rib has made the entire circumference of the tube, you separate the surplus by suddenly darting a strong jet of fire upon the point where it should be divided; and you continue to expose the tube to the flame, always turning it round, until the ring of glass is fully incorporated with the glass it was applied to. You then remove the instrument from the flame, taking care to anneal it in so doing. During this operation you must take care to prevent the sinking together of the sides of the tube, by now and then turning the sides of the interior. It is a *red heat*, or a *brownish red heat*, that is best adapted to this operation.

Widening.—When you desire to enlarge the diameter of the end of a tube, it is necessary, after having brought it to a soft state, to remove it from the flame, and to press the sides of the glass outwards by means of a large rod of iron with a conical point. The tube must be again heated, and again pressed with the conical iron rod, until the proper enlargement is effected. This operation is much the same as that of bordering a tube with projecting edges.

Drawing out.—You can *draw out* or *contract* a tube either in the middle or at the end. Let us in the first place consider that a tube is to be drawn out in the middle. If the tube is long, you support it with the right hand *below*, and the left hand *above*, by which means you secure the force that is necessary, as well as the position which is commodious, for turning it continually and uniformly in the flame. It must be kept in the jet till it has acquired a *cherry red heat*. You then remove it from the flame, and always continuing gently to turn it, you gradually separate the hands from each other, and draw the tube in a straight line. In this manner you produce a thin long tube in the centre of the original tube, which ought to exhibit two

uniform cones where it joins the thin tube, and to have the points of these cones in tha prolongation of tha axis of the tube.

To draw out a tube at its extremity, you beat the extremity till it is in fusion, and then remove it from the flame; you immediately seize this extremity with the pliers, and at the same time separate the two bands. The more rapidly thia operation is parformed, the glass being supposed to be well softened, the more capillary will the drawn-out point of the tube be rendered. Instead of pinching the fused end with the pliers, it is simpler to bring it to the end of a little auxiliary tube, which should be previously heated, to fusa the two together, and then to draw out tha end of the original tube by means of the auxiliary tube. In all cases, the smaller the portion of tube softened, the more abrupt is the part drawn out.

When you desire to draw out a point, from the side of a tube, you must heat that portion alone, by holding it fixedly at the extremity of the jet of flame. When it is sufficiently softened, solder to it the end of an auxiliary tube, and then draw it out. A *red heat*, or a *cherry red heat*, is best adapted to this operation.

Choking.—We do not mean by *choking* the closing or stopping up of the tube, but simply a diminution of the interior passage, or bore. It is a sort of contraction. You perform the operation by presenting to the flame a zone of the tube at the point where the contraction is to be effected. When the glass is softened, you draw out the tube, or push it together, according as you desire to produce a hollow in the surface of the tube, or to have the surface even, or to cause a ridge to rise above it. A *cherry red heat* is the proper temperature to employ.

Sealing.—If the sides of the tube to be sealed are thin, and its diameter is small, it is sufficient to expose the end that you wish to close to the flame of the lamp. When the glass is softened it sinks of itself, in consequence of the rotatory motion given to it, towards the axis of the tube, and becomes rounded. The application of no instrument is necessary.

If the tube is of considerable diameter, or if the sides are thick, you must soften the end, and then, with a metallic rod or a flat pair of pliers, mould the sides to a hemisphere, by bringing the circumference towards the centre, and continuing to turn the tube in tha flame, until the extremity is well sealed, and perfectly round.

If you desire the sealed part to be flat, you must press it, while it is soft, against a flat substance. If you wish it to be concave, lika the bottom of a bottle, you must suck air from the tube with the mouth; or instead of that, force the softened end inwards with a metallic rod. You may also draw out the end till it be conical, or terminate it with a littla button. In some cases tha sealed end is bent laterally; in others it is twirled into a ring, having previously been drawn out and stopped in the bore. In short, tha form given to the sealed end of a tube can be modified in an infinity of ways, according to the object for which tha tuba may ba destined. The operation of sealing succeeds best at a *cherry red heat.*

Blowing.—Tha construction of a great number of philosophical instruments requires that he who would make them should exercise himself in the art of blowing *bulbs* possessing a figure exactly spherical. This is one of the most difficult operations.

To blow a bulb at the extremity of a tube, you commence by sealing it; after which, you collect at the sealed extremity more or less glass, according to the siza and the solidity which you desire to give to the bulb. When the end of the tube is made thick, completely sealed, and well rounded, you elevate the temperature to a *reddish white* heat, taking care to turn tha tube continually and rapidly between your fingers. When the end is perfectly soft you remove it from tha flame, and, holding the tube horizontally, you blow quickly with the mouth into the open end, without discontinuing for a single moment the movement of rotation. If the bulb does not by this operation acquire the necessary size, you soften it again in the flame, while under the action of which you turn it very rapidly, lest it should sink together at tha sides, and become deformed. When it is sufficiently softened you introduce, in the same manner as before, a fresh quantity of air. It is of importance to observe that, if it be of a large diameter it is necessary to contract the end by which you are to blow, in order that it may be turned round with facility while in the mouth.

When the bulb which you desire to make is to be somewhat large, it is necessary, after having sealed the tube, to soften it for the space of about half an inch from its extremity, and then with the aid of a flat piece of metal, to press moderately and repeatedly on the softened portion, until the sides of the tube which are thus pressed upon, sink together, and acquire a certain degree of thickness. During this operation, however, you must take cara to blow, now and then, into the tube, in order to retain a hollow space in tha midst of the little mass of glass, and to hinder the bore of the tube from being closed up. When you have thus, at the expense of the length of the tube, accumulated at its extremity a quantity of glass sufficient to produce a bulb, you have nothing more to do than to heat the matter till it is raised to a temperatura marked by a *reddish white* color, and then to expand it by blowing.

We have already observed, and we repeat here, that it is indispensably necessary to hold tha glass *out* of the flame during the act of blowing. This is the only means of maintaining uniformity of temperature in the whole softened parts of the tube, without which it is impossible to produce bulbs with sides of equal thickness in all their extent.

(*Continued on page 263.*)

SYMPATHETIC INKS.

Sympathetic inks are colors with which a person may write, and yet nothing appear on the paper after it is dry, till some means are used, as holding the paper to the fire, or rubbing it over with some other liquor, to make it visible.

These kinds of inks may be divided into seven classes, with respect to the means used to make them visible; viz. 1, such as become visible by passing another liquor over them, or by exposing them to the vapour of that liquor; 2 those that do not appear so long as they are kept close, but soon become visible on being exposed to the air; 3, such as appear by strewing or sifting some very fine powder of any color over them; 4, those which becoma visible by being exposed to the fire; 5, such as become visible by heat, but disappear again by cold or the moisture of the air; 6, those which become visible by being wetted with water; and 7, such as appear of various colors.

The first class contains four kinds of ink viz. solutions of lead, bismuth, gold, and green vitriol, or sulphate of iron. The two first become visible by the contact of sulphureous liquids or fumes. For the first, a solution of common sugar of lead in water answers very well. With this solution write with a clean pen, and the writing when dry will be totally invisible; but if it be wetted with a solution of sulphuret of potass, or of orpiment, dissolved by means of quicklime, or exposed to the strong vapours of these solutions, the writing will appear of a brown color, more or less deep, according to the strength of the sulphureous fume. By the same means the solution of nitrate of bismuth will appear of a deep black.

The sympathetic ink prepared from gold depends on the property by which that metal precipitates from its solvent on the addition of a solution of tin. Write with a solution of gold in nitro-muriatic acid, and let the paper dry gently in the shade; nothing will appear for the first seven or eight hours. Dip a pencil in the solution of tin, and draw it lightly over the invisible characters, they will immediately appear of a purple color.

Characters written with a solution of green vitriol will likewise be invisible when the paper is dry; but if wetted with an infusion of galls, they will immediately appear as if written with common ink. If, instead of this infusion, a solution of an alkaline prussiate be used, the writing will appear of a deep blue.

To the second class belong the solutions of all those metals which are apt to attract oxygen from the air, such as lead, bismuth, silver, &c. The sympathetic ink of gold already mentioned belongs also to this class; for if the characters written with it are long exposed to the air, they become by degrees of a deep violet color, nearly approaching to black. In like manner, characters written with a solution of nitrate of silver are invisible when newly dried, but being exposed to the sun, appear of a grey color, like slate. To this class also belong solutions of sugar of lead, nitrates of copper and of mercury, acetate of iron, and muriate of tin. Each of these has a particular color when exposed to the air; but they corrode the paper.

The third class of sympathetic inks contains such liquids as have some kind of glutinous viscosity, and at the same time are long in drying; by which means, though the eye cannot discern the characters written with them upon paper, the powders strewed upon them immediately adhere, and thus make the writing become visible. Of this kind are urine, milk, the juices of some vegetables, weak solutions of the deliquescent salts, and other liquids.

The fourth class, comprehending all those that become visible by being exposed to the fire, is very extensive, as it contains all those colorless liquids in which matter dissolved is capable of being reduced, and of reducing the paper into a sort of charcoal by a small heat. Sulphuric acid, diluted with as much water as will prevent it from corroding the paper, makes a good ink of this kind. Letters written with this fluid are visible when dry, but instantly on being held near the fire appear as black as if written with the finest ink. Juice of lemons or onions, a solution of sal ammoniac, green vitriol, &c. answer the same purpose.

The fifth class comprehends only three substances, two of the salts of cobalt, the nitrate and the acetate; and also the muriate of copper; these are by far the most curious of the sympathetic inks. To prepare them it is only necessary to immerse the metals above-mentioned in the proper acids, by the assistance of heat they will be dissolved, and the ink formed. It may be used as common ink is, using, as in all other instances of secret writing, a new *quill* pen. When the paper written upon is heated, the nitrate of cobalt appears blue, the acetate of cobalt green, and the muriate of copper yellow. Pictures may be painted with these inks, and if rightly designed, will show as a winter scene when cold, but exposed to the warmth of a fire, the trees, grass, and sky assume a colored garb.

The sixth class comprehends such inks as become visible when characters written with them are wetted with water. They are made of all such substances as deposit a copious sediment when mixed with water, dissolving only imperfectly in that fluid. Of this kind are dried alum, sugar of lead, vitriol, and other substances. We have, therefore, only to write with a strong solution of these salts upon paper, and the characters will be invisible when dry; but when we apply water, the small portion of dried salt cannot again be dissolved in the water. Hence the insoluble part becomes visible on the paper, and shows the characters written in white, grey, brown, or any other color which the precipitate assumes.

Lastly, characters may be made to appear of a fine crimson, purple, or yellow, by writing on paper with a solution of muriate of tin, and then passing over it a pencil dipped in a decoction of cochineal, Brazil-wood, log-wood, yellow-wood, or the like.

MOUNTING MICROSCOPIC OBJECTS.

(Resumed from page 196, and concluded.)

The most valuable material in which to mount semi-opaque objects, and those which are apt to shrivel in drying, is Canada-balsam. In fact so superior are the transparency, and beauty of sections of wood, and dissections of insects, that without this substance many of the more delicate organizations of the animal and vegetable kingdom would be very inadequately distinguishable.

To mount objects in balsam it is necessary to prepare a number of the glass sliders, mentioned before; and also some other pieces of glass, about half an inch square each. Make one of the sliders, (which we will suppose to be two inches long, and three-quarters of an inch wide,) and also one of the small glass squares, rather warm, by a spirit lamp, holding them at the fire, or putting them on the hob of a heated stove, and taking the large piece of glass put upon it a drop of balsam, which on account of the warmth will spread a little. The object, which should have been soaking for a few minutes in spirits of wine, is to be placed carefully upon the drop of balsam, spreading it out as may be requisite, and the smaller glass piece, still warm, placed upon the object—pressing the two glasses together with the thumb and finger, which will drive the balsam, now liquid, into the various pores and interstices of the object, and occasion the glasses to adhere together firmly, and yet completely retaining their transparency. The balsam which exudes from the various sides may be neatly pared away afterwards, or else, as is more usually done, may be laid up as a bevelled edge to the smaller glass, in the same manner as a glazier would leave the putty around a pane of glass. The only thing to be guarded against in setting up objects in Canada balsam is to prevent any bubbles of air from being inclosed between the

two pieces of glass, as such, however minute they might be, would, when magnified, become e serious annoyance, and often lead observation to deceptive results.

Those who try the above process, for the first time, must not expect fully to succeed, so much depends upon the nicety and care taken with the manipulation. We, therefore, give the following slight variation of the above, which is the method we have practised with equal, if not greater, success then the foregoing.

Put a large drop of Canade balsam on one of the usual sliders—place carefully upon the centre of this the proposed object, previously soaked in ether or spirits of turpentine—then heat the glass by holding it over a spirit lamp, or otherwise, and as the balsam becomes hot, and consequently fluid, the object will sink down into it, or should it be too light, a needle will assist the immersion—then heat the smaller piece of glass, and place it very carefully on the drop of balsam, holding the glass so that it shall touch the convex top of the balsam first, press the finger gently, and gradually on the top, and there hold it until the glass has become pertially cold, and consequently the balsam congealed; if this be done with ordinary attention the air bubbles will be completely got rid of.

Opaque Objects are viewed either by direct or by reflected light. To show them by the first method, the objects, which are usually particles of minerals, corallines, the seed-vessels of ferns, the shape of seeds, the larger parts of insects, minute shells, &c. may be merely fastened by a little gum water to common sliders, e piece of card, or something similar. When to be viewed they are to be placed on the usual object frame of the microscope, and the light of a lamp or candle thrown direct upon them; and, in order that this light may be in some degree concentrated, a plano-convex lens may be interposed between the lamp and the object; adjusting the glasses to the proper focus a clear delineation will be obteined.

A second method is, that the object should be illuminated by reflection. In this case the light passes upwards from the lower mirror, it strikes a semi-circular reflector placed close below the object lens, and from this the light is concentrated, and thrown to e point at a little distance below. The object should be placed exactly et this point. It is evident that no reflection could take place if the common large opaque sliders are used, because they would intercept the rays of light as they pass upwards. To prevent this source of obscurity, the objects may be mounted on very small circles of card, or paper, which occupying the exact centre, where of necessity there must be a hole in the reflector, very little of the light is interrupted. The best method of making these discs, one of which is represented below, is to procure a piece of thick

chamois, buck-skin, or other soft leather, and paste a piece of black paper on one side, and a piece of white upon the other, (the black peper must not be glossy.) Punch out of this prepared leather a number of round pieces, not more than three-eigbths of an inch in diameter, and thrust through each a large pin. They are now ready for use, and it is only necessary to glue or gum the object on one side, and a number for reference, or the name of the substance, on the other. When to be used the point of the pin may be stuck into a piece of cork fastened to tha forceps, usually accompanying the microscope, and thus brought exactly to the centre of the field of view. When not in use these prepared discs take up a very inconsiderable space, as they may be kept easily in a small box, the bottom of which is lined with cork, into which the points of all of them may be thrust, in the same manner as insects in a cabinet. It is to be observed, that a very low magnifying power is all that is required for the examination of the usual class of opaques.

ANALYSIS OF MINERALS.

THE METALS AND EARTHS SUBJECTED TO THE HUMID PROCESS.

(Resumed from page 222, and concluded.)

It mey be of some advantage to point out to the learner, the most distinguishing properties by which the various metals may be detected, with a view of facilitating the examination of such minerals as may present themselves to his notice; but at the same time it may be necessary to observe, that, on exposing a portion of ore to the action of en acid, the solvent mey become charged with various proportions of three or four different metels, and perhaps also one or two earths; this complication will of course prevent the result being so striking as would be the case if the solution were of a more simpla neture; and the circumstance is mentioned to caution the young student against being deterred from an unexpected difficulty at the outset. Should he have reason to suppose that he has commenced with an investigation beyond his power, let him set the specimen aside, end by operating on others of less complicated natures, he will gradually extend his sphere of observation, and after a short time have the satisfaction of resuming the examination of the subject which at first baffled his attempts.

Gold.—Muriate of tin throws down a purple precipitate, and green sulphate of iron a brown one, which is metallic gold.

Silver, by the solution of e few grains of common salt, or any other substance containing murietic acid. On immersing a piece of copper wire it will become coated with a film of metallic silver, of e dark sooty eppearance.

Copper affords a beautiful blue by the addition of ammonia, and coats the surface of a piece of polished iron with a film of copper.

Iron, by the vivid Prussian blue which is immediately formed, on the addition of one or two drops of prussiate of potash.

Lead, by being precipitated upon zinc, or by common salt, or any of the other muriates. To distinguish it from silver, see the article muriatic acid.

Mercury, by an orange precipitate, which it affords with the pure alkalies, or by exposing the mineral suspected to contain it to tha action of the blow-pipe, when the fumes will coet the surface of a piece of copper, (a bright half-penny for example,) held over the charcoal, with a thin silver-like crust of mercury.

Tin, by the purple precipitate afforded by muriate of gold.

Cobalt, by the bright blue bead afforded by exposing a *very small* particle of it to the blowpipe with the glass of borax.

Manganese, by the amethystine tinge which the bead of borax assumes under the same circumstances,

and by its yielding the suffocating fumes of chlorine when heated with muristic acid.

Antimony and *Bismuth* both yield a white precipitate when the acid containing them in solution is poured into water; but they may be distinguished by the blowpipe, before which the antimony flies away in white fumes, which coat the charcoal to some distance.

Arsenic, by the unpleasant garlic-like odour which it yields before the blowpipe, at the same time affording white fumes.

Zinc, by the white precipitate it affords with ammonia, in an excess of which it re-dissolves, also by affording *brass* when carefully fused with a few grains of copper filings before the blowpipe.

The striking characteristics of the several metals, arising from their odour when exposed to heat, or the color of their precipitates when acted on by tests, afford a much greater facility in their detection than exists with the earths. The latter, with the exception of the peculiar earthy smell arising usually from the presence of clay, (but existing also in some minerals containing but little alumine,) yield scarcely any odour; the colors they exhibit are always due to metallic oxides; and their precipitates are invariably white; it accordingly requires a nicer discrimination to satisfy the mind with respect to them; but a habit of observation will gradually render their principal features familiar. The following hints may perhaps be serviceable; it is admitted that some of them are not confined to the particular substance referred to, but the exceptions relate to objects much less likely to be submitted to examination. Thus, the hardness and insolubility of silex apply equally to the purer forms of alumine as existing in sapphire and some other gems which are not likely to become the subjects of a young mineralogist's experiments.

Silex usually imparts a considerable degree of hardness and insolubility: minerals which chiefly consist of it are, for the most part, transparent; and although many may appear by the knife to be soft, it will be found to arise from the presence of other earths in a state of chemical combination; the particles of silex still retaining their hardness, as will be proved by rubbing some of the powdered mineral over the moistened surface of a piece of glass, which will speedily lose its polish.

Lime is immediately precipitated by oxalate of ammonia, but which also throws down barytes and strontian; these three earths are precipitated by the alkaline sulphates; and the sulphate of lime may be separated by the effusion of a large quantity of water slightly mixed with sulphuric acid, the sulphates of barytes and strontian being totally insoluble.

Alumine, in a state of great purity, affords gems possessing a high degree of hardness and brilliancy; while its combinations are most frequently soft and of a dull earthy appearance, yielding the peculiar smell of clay when breathed upon, and adhering to the tongue or moistened lip: should the specimen not contain any large portion of metal, the presence of alumine may be ascertained by dropping a very small quantity of strong nitrate of cobalt on a particle of it; on applying the blowpipe heat, a blue color will appear, whose vividness will be in proportion to the purity of the alumine: this will not be the case with any of the other earths except zircon, an ingredient of very rare occurrence.

Magnesia may be detected by pouring into the solution a few drops of concentrated *neutral* carbonate of ammonia, and then adding a little phosphate of soda, when a precipitate will be obtained, consisting of phosphoric acid combined with soda and magnesia; or, after precipitating all the earths by any carbonated alkali, wash the precipitate and pour over it moderately diluted sulphuric acid: silex, lime, barytes, or strontian, will remain undissolved; magnesia or alumine will form a soluble combination, and to distinguish them add a particle or two of potash, and after moderately evaporating the mixture in a watch-glass, set it by to crystallize. Should the earth in combination be magnesia, the result will be the well-known Epsom salts; but, if alumine, the produce will be alum.

Barytes or *Strontian* are almost immediately known by the superior weight of their combinations: they are found united to the sulphuric and carbonic acids only: with the former they are insoluble either in water or any of the acids; with the latter they dissolve in diluted nitric or muriatic acid, and may be discriminated by the following experiments: evaporate the mixture to dryness and expose a small quantity of the residue to the blowpipe; strontian will impart a crimson color to the flame, a property not possessed by barytes.

The remaining metals and earths, being of comparatively rare occurrence, do not call for particular notice in a short sketch of this description.

The learner possessing a mineral, with the nature of which he is acquainted, may proceed as follows:—If it be both earthy and metallic, he should separate one from the other, and reduce a few grains to powder, which he should place in a watch-glass, and add a few drops of nitric acid; if no action be perceived, it may be held over the flame of the lamp, until ebullition takes place, when the substance will be more or less dissolved; then pour the liquid into a glass tube, previously containing a little water, and proceed by applying the tests, or metallic rods, before explained.

Or expose the substance to the yellow-flame of the blowpipe, after which pulverize it, and apply the magnet to it which will frequently determine the substance, iron being so generally disseminated: or, place it in the hollow of the charcoal, with an equal quantity of glass borax, and expose it to the blue flame, when it will melt into a bead surrounded by the borax forming scoria. Care must be taken not to apply too much heat, as some of the metals evaporate or become oxidated.

STEAM TOWING ON CANALS.

The experimental improvements in this branch of transit and navigation, which have for some time been making great progress in Scotland, under the direction of Mr. Macneil, civil engineer, were brought to a very satisfactory proof, a fortnight ago, on the Forth and Clyde Canal. The locomotive, Victoria, was employed on this occasion, and some of the leading results were as follows:—With a passenger-boat laden with passengers (an average load,) a rate of twenty miles per hour was attained; and it was evident that the only limit to the speed was that of the power of the engine. Eight trading vessels were ranged in a line attached to each other, and the first to the locomotive; they were, together, 317 tons register, 364 tons actual load, and the draught of water, severally, 8 ft., 8 ft. 9 in., 8 ft. 6 in., 6 ft., 7 ft. 10 in., 4 ft., 4 ft. 6 in. For the haulage of this amount of tonnage, at the usual rate of 1¼ mile per hour, about twenty horses are employed, under the most favorable circumstances.

The Victoria towed it with about one-fourth only of her steam power, at a rate of 2¼ miles per hour. The ease with which she did this justified the opinion of several spectators, qualified to judge, that double this amount of tonnage might have been mastered by her with very little or any diminution of her speed. The wave produced by the motion of the large vessels at the rate they were towed was of the ordinary size and character; that of the rapid boats, though large, was by no means so formidable as to create any fear that it would be any obstacle to the adoption of this mode of conveyance. In one of the latter experiments, four passenger-boats were towed in a line, and the volume of the waves was evidently broken up into numberless smaller waves, spreading over the whole surface of the canal, and resembling a great ripple. The reverse of this occurred when two passenger-boats were lashed together abreast, as a twin boat; the wave then extended in a fine regular glassy swell from the boats to the shores. These effects point out the fact that the form, magnitude, position, &c., of the wave are all susceptible of modification, as little is to be apprehended from curves, of whatever character. In the railway upon which the engine travelled there was a curve of double flexure, the radius part of which was less than a third of a mile. No sensible retardation in her speed was produced by it, nor was any disposition observed, even in the most rapid transits, to run off the rails. To prevent the latter effect occurring from the resistance of the vessels towed, the outer rail was laid a little lower in level than the inner one, so as to give the engine a slight tendency to descend towards the outward rail. This also prevents, in a certain degree, the overturning of the engine by a strong pull. During the whole of the several series of experiments, not a single fact occurred to check the expectation that this union of the railway and the canal will, wherever practicable, take the precedence of every other in point of combined convenience, safety, rapidity, and economy.

ENGRAVINGS BY VOLTAIC ELECTRICITY.

We lately published, (page 199,) M. Jacobi's letter to Mr. Faraday, in which he described his attempts to copy in relief engraved copper-plates, by means of voltaic electricity. We have since received a communication from Mr. Thomas Spencer, of Liverpool, from which it appears that that gentleman has for some time been independently engaged on the same subject; and that he has not only succeeded in doing all that M. Jacobi has done, but has successfully overcome those difficulties which arrested the progress of the latter. It is unnecessary here to enter on the question of priority between these gentlemen. To Mr. Spencer much credit is certainly due for having investigated, and successfully carried out, an application of voltaic electricity, the value of which can hardly be questioned. The objects which Mr. Spencer says he proposed to effect, were the following:—"To engrave in relief upon a plate of copper—to deposit a voltaic copper-plate, having the lines in relief—to obtain a fac-simile of a medal, reverse or obverse, or of a bronze cast—to obtain a voltaic impression from plaster or clay—and to multiply the number of already engraved copper-plates." The results which he has obtained are very beautiful; and some copies of medals which he has forwarded to us are remarkably sharp and distinct, particularly the letters, which have all the appearance of having been struck by a die.

Without entering into a detail of the steps by which Mr. Spencer brought his process to perfection, many of which are interesting, as showing how slight a cause may modify the result, we shall at once give a description of his process.

Take a plate of copper, such as is used by an engraver; solder a piece of copper wire to the back part of it, and then give it a coat of wax—this is best done by heating the plate as well as the wax—then write or draw the design on the wax with a black lead pencil or a point. The wax must be now cut through with a graver or steel point, taking special care that the copper is thoroughly exposed in every line. The shape of the tool or graver employed must be such that the lines made are not V-shaped, but as nearly as possible with parallel sides. The plate should next be immersed in dilute nitric acid, —say three parts water to one acid; it will at once be seen whether it is strong enough, by the green color of the solution and the bubbles of nitrous gas evolved from the copper. Let the plate remain in it long enough for the exposed lines to get slightly corroded, so that any minute portions of the wax which might remain may be removed. The plate thus prepared is then placed in a trough separated into two divisions by a porous partition of plaster of Paris or earthenware,—the one division being filled with a saturated solution of sulphate of copper, and the other with a saline or acid solution. The plate to be engraved is placed in the division containing the solution of the sulphate of copper, and a plate of zinc of equal size is placed in the other division. A metallic connexion is then made between the copper and zinc plates, by means of the copper wire soldered to the former, and the voltaic circle is thus completed. The apparatus is then left for some days. As the zinc dissolves, metallic copper is precipitated from the solution of the sulphate on the copper-plate, wherever the varnish has been removed by the engraving tool. After the voltaic copper has been deposited in the lines engraved in the wax, the surface of it will be found to be more or less rough, according to the quickness of the action. To remedy this, rub the surface with a piece of smooth flag or pumice-stone with water. Then heat the plate, and wash off the wax ground with spirits of turpentine and a brush. The plate is now ready to be printed from at an ordinary press.

In this process, care must be taken that the surface of the copper in the lines be perfectly clean, as otherwise the deposited copper will not adhere with any force, but is easily detached when the wax is removed. It is in order to ensure this perfect cleanness of the copper, that it is immersed in dilute nitric acid. Another cause of imperfect adhesion of the deposited copper, which Mr. Spencer has pointed out, is the presence of a minute portion of some other metal, such as lead, which, by being precipitated before the copper, forms a thin film, which prevents the adhesion of the subsequently deposited copper. This circumstance may, however, be turned to advantage in some of the other applications of Mr. Spencer's process, where it is desirable to prevent the adhesion of the deposited copper.

In copying a coin or medal, Mr. Spencer describes two methods: the one is by depositing voltaic copper on the surface of the medal, and thus forming a mould, from which fac-similes of the original medal may readily be obtained by precipitating copper into it. The other is even more expeditious. Two pieces of clean milled sheet lead are taken, and the medal being placed between them the whole is

subjected to pressure in a screw press, and a complete mould of both sides is thus formed in the lead, showing the most delicate lines perfect, (in reverse.) Twenty, or even a hundred of these may be so formed on a sheet of lead, and the copper deposited by the voltaic process with the greatest facility. Those portions of the surface of the lead which are between the moulds, may be varnished to prevent the deposition of the lead, or a whole sheet of voltaic copper having been deposited, the medals may afterwards be cut out. When copper is to be deposited on a copper mould or medal, care must be taken to prevent the metal deposited adhering. This Mr. Spencer effects by heating the medal, and rubbing a small portion of wax over it. The wax is then wiped off, a sufficient portion always remaining to prevent adhesion.

Enough has been said to enable any one to repeat and follow up Mr. Spencer's interesting experiments. The variations, modifications, and adaptations of them are endless, and many new ones will naturally suggest themselves to every scientific reader.—*Athenæum.*

CRYSTALLIZATION OF ICE, AND OF VEINS OF ICE IN ICE.

BY PROFESSOR HESSEL.

For some time past I have been occupied with observations on the different forms of crystallization. The crystallization of water, under certain conditions, induced by artificial means, formed also the subject of my inquiries. I shall here briefly detail one of my experiments, which I have repeated frequently of late, as I reckon it not unimportant for the doctrine of veins, whose different modes of origin can, in my opinion, only be satisfactorily explained by collecting as many examples as possible of the formation of veins, and vein-like masses, since the commencement of historical epochs. So that we have then only to inquire whether this or the other vein, or assemblage of veins, bears most resemblance to lava-veins in lava, to veins which may be considered as canals filled up by mineral springs of some sort or other, to fissures filled by sublimations, to fissures which have been the outlets for alternate streams of fluid, or elastic matters, and which have been gradually closed by the deposition of solid matters, or to fissures which have been filled by infiltration from above, &c.; or whether these veins are to be viewed as the result of the contemporaneous congelation (crystallization) of two or more heterogeneous masses, one of which has filled fissures in the other, but which have never been in reality open.

Upon this supposition every experiment on the origin of vein-like masses, however insignificant it may appear, must be considered as an augmentation of our resources for the elucidation of the origin of those veins which have not been observed by man, so that this communication is of interest, not merely to the crystallographer, but also to the geognost.

I set aside, in a warm room, a mixture of fine clay and water, in which the latter was somewhat in excess, so that the thin mud could be easily stirred about with a fine hair brush. Upon resting for some time, it divided into two portions, the undermost of which consisted of moist clay, and the upper, at least considerable, of clear water. During the cold days which we had in Dec. (5° — 10° F.), I exposed the mixture after agitation to crystallization, or freezing. Crystallization did not take place till the mass had returned to the state of rest, but before the separation took place between the clay and the water. The structure of the frozen mass varied in different experiments. In every case, however, frozen mud, and frozen clear water, could be distinguished from each other. But the latter did not occur as a stratum at the upper part of the mass, but was distributed through the substance of the frozen mud.

1. The most common appearance was like that of small quartz veins, traversing, in different directions, a siliceous slate. The same as in hand specimens of siliceous slate, when two of the quartz veins meet one another, they traverse one another, shift one another, or mutually cut each other off, &c., was observed distinctly in the present instance. The principle that the traversing vein is newer than the one traversed, could not be easily demonstrated to be correct in these ice veins in the frozen mud: nor could the idea of the contemporaneous formation of veins with the surrounding rock be admitted as unconditionally correct. In these ice veins there was, apparently, a real cutting across of one vein by another, so that the traversed vein beyond the traversing pursued its original course, or was diverted somewhat from its position, but more frequently one was completely cut off by the other. Often we could suppose a true wedging out of such a vein, without a previously existing empty fissure promoting its formation.

2. Often the water-ice was distributed through the frozen mud, like the quartz in the felspar of graphic granite. The surface formed by cutting and polishing, exhibiting, like the latter Hebraic, Arabic, and Chinese characters; and these were still more characterised on the dark surface of the mud, than the grayish-white quartz on the whitish felspar.

3. Another mode of distribution of the water-ice in the frozen mud, was its forming vertical plates, which were so grouped, that the surface of the mass of mud on its middle section, resembled a concentrically radiated crystalline mass, the rays diverging from the centre outwards. Several of these groups of rays were observed. Each ray projected to a considerable height above the surface of the mud.

With regard to the causes of the three different appearances that I have enumerated, they appear to me to depend upon differences in the excess of water in the mud, on the temperature of the mass before it is exposed to congelation (sometimes boiling water was used), and especially the rapidity of the congelation. Farther I can give no explanation.

QUERIES.

132—Requested a receipt for, and method of French polishing. See page 270.

133—What kind of chalk, or other similar substance, will mark clearly upon glass? See page 413.

134—How is the ox-gall paste, used by draughtsmen, prepared? See page 259.

135—How to prepare moist water colors, so that they may retain their moisture in the open air?

136—How to prepare colored crayons? See page 259.

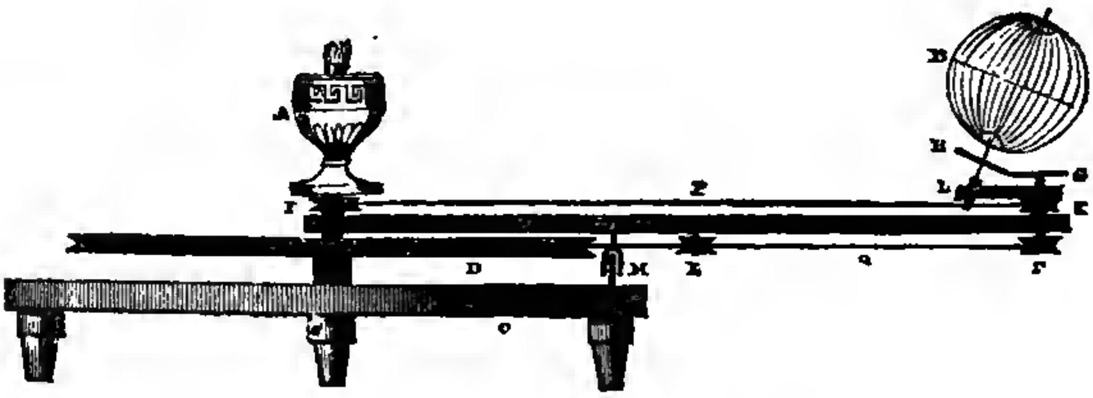
137—How is oil best prepared for the watch-makers, &c.? See page 268

138—How is the raising composition for Chinese Japanning work made? Answered on page 271.

139—How may prints, &c., be transferred to wood? See page 271.

140—How are magnets made? See pages 248 and 273.

Fig. 1.



HORIZONTAL TELLURION.

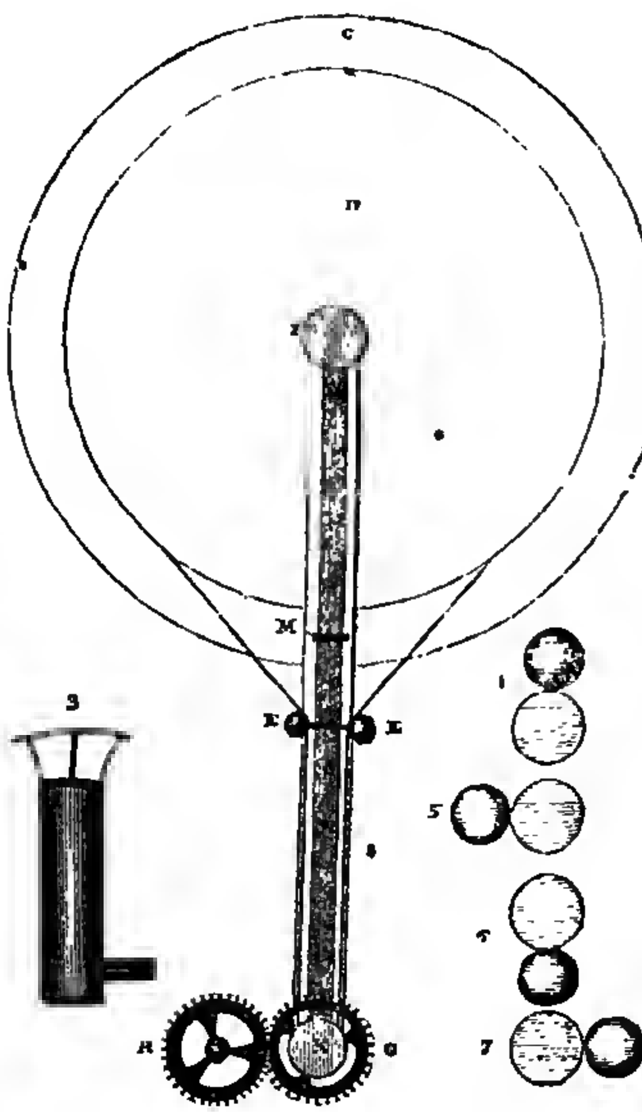


Fig. 2.

HORIZONTAL TELLURION.

All who have witnessed the splendid apparatus, used by Messrs. Adams, Wallis, Howell, and other lecturers on astronomical science, must have been delighted at the magnitude of the tellurions, orreries, &c., and the perfection of workmanship which their accuracy of motion implies. At a former period we not ony admired these machines, but had an anxious desire to learn the character of the machinery, and the contrivances which produced such different effects at various parts of the lectures. Believing that there are numbers of our readers who would also wish some information upon the subject, we give this week an account of the *Horizontal Tellurion*, or machine to show the effect of the earth's rotations, and the obliquity of her axis; the one upon her axis, showing the succession of day and night; her revolution around the sun, in the period of a year, and her position at various times, causing the succession of the seasons, and the varied length of light and darkness, or day and night.

Fig. 1.—A is a lamp, representing the sun, which is fixed to the upper part of the frame, so as to turn round with the rest of the machine. B is a globe, representing the earth, which in the figure is shown to be placed at an angle of 23½ degrees, as it is in nature, but it is made capable of motion around its axis, being merely fitted into the socket L, and also being set upright, so that its axis may be perpendicular. The vertical lines drawn upon it represent the twenty-four meridians—the straight line is the equator—the curved lines around the poles are the polar circles. C is the table upon which the moveable portion of the apparatus stands, and which turns round upon a central vertical wooden axis, which holds at various heights the wheel D; the frame or spindle O; the small wheel I; and the lamp A. A, I, O, and D, being fastened together. D is a multiplying wheel, about two feet in diameter, fixed immoveable to the spindle in the centre. E E are two small wheels (seen better in Fig. 2), intended to confine the cord connecting D and E. These two wheels or pullies are added merely for the sake of convenience, so is also the roller wheel M, which is merely intended to bear the weight of the upper part of the machine: it runs upon the rim of the table C. F is a pulley, about one inch in diameter, which is fixed to, and consequently turns the toothed wheel G. This turns the toothed wheel H, and this last being fixed to the axis of the earth turns that round, which it is enabled to do because of the extreme pole of the axis being free to move in a socket, near the end of L; and also the earth may, by moving this socket in a small groove prepared for it, be made to assume any degree of obliquity, or to be fixed perpendicular to its orbit of rotation. L is a short bar of wood, free to turn round on the centre at K, where a pulley, of about an inch diameter, is fixed, and turns with it. I is another pulley, of exactly the same diameter as K, the cord P passing from one to the other. O shows the cord which connected the wheels below the frame. O is a bar of wood or metal (it may be three feet long, half an inch wide, and two inches broad. This part is to sustain, and properly connect the various parts with each other.

Fig. 2 shows the same parts in section, with the same letters as in the above description. *Fig.* 3 represents a blackened tin case, intended to place over the *sun*, or lamp, to confine the light to a particular part of the circle, that it may shine only upon the *earth*. This latter must be made with as little weight as possible, that it may turn the more readily: it may be made of several folds of paper, pasted upon a round body, and cutting the paper, in two when dry, the internal globe taken out, and the two parts afterwards glued together, whitened, and marked with the lines of longitude, &c.

To use the above Tellurion it is only necessary to light the lamp, place the cover upon it, and turn round the frame O. Now it will be evident, that the globe representing the earth will have two motions, one around its axis — the other around the sun. The wheel D being fixed, and two feet diameter, and the pulley F moveable, and one inch diameter; each revolution of the frame O around the light will cause E to turn round twenty-four times. G as it is connected with F, and H with G, and the earth with H, the latter will also turn twenty-four times on its axis during one revolution in its orbit; or if a greater number be required, a difference in the size of the wheels G and H will accomplish the purpose. The pulley I being fixed to the frame, and K being of the same size as I, it will turn round exactly once in a revolution of I or O. L being fixed to K, and turning with it, will of necessity bring the earth in four different positions, at an interval of a quarter of a circle, or three months each. Now it is evident, that exactly one half of the earth will always be illuminated, and if the parallelism of the axis be preserved, that is, if the central line upon which the globe turns be exactly perpendicular, the *terminator*, or line of darkness, will, at all parts of its revolution, extend exactly from pole to pole, consequently no variation will take place in the length of day and night throughout the year; and as seasons depend upon the more or less direct and continued influence of the sun upon a particular part of the earth's surface, no difference of season would take place; but when the earth's axis is placed as in nature, and as represented in our figure, at an angle of 23½ degrees with the plane of her orbit, the earth in its annual revolution will present itself only in this position on two days in the year: namely, on the 21st of March and the 21th September, or what we designate the vernal and autumnal equinoxes when proceeding forwards from the vernal equinox, it shall have passed 90 degrees, or a quarter of a circle, the north pole of the earth is fully exposed to the sun's light and heat, and the terminator will be seen to pass considerably beyond the poles, even as far as the polar circle, leaving the whole of the south frigid zone in complete obscurity, or in one of their long and dreary winters, while we enjoy the warmth of a sun approaching to within 28 degrees of our zenith, and shining upon us for 16 hours at a time—now, that is on the 21st of June, occurs the summer solstice, or our longest day; after which, the days shorten with it, and lengthen in the southern hemisphere, until on the 21st of December, our shortest day, or mid-winter comes on, and the inhabitants of southern climes rejoice in that summer which we look forward to return six months afterwards.

Fig. 4, 5, 6, 7, shows the position of the earth in four equi-distant periods of its revolution.

THE ART OF STAINING GLASS.

There are three methods of coloring glass; one by laying upon it a coat of some transparent colored varnish, or, drawing a design in various colors, as

is exemplified in painting magic lantborn sliders, (see Part 2). 2nd. By mixing with it during its first manufacture and while in a state of fusion, some of the metallic oxydes; in this manner colored drinking glasses, hyacinth glasses, beads, illumination lamps, and often sheet glass is made. Also, upon this process, if well conducted, depends the successful imitation of factitious gems, or as they are commonly called *paste* jewels. The following materials are usually employed at the glass houses to produce the various tints required in the articles that are ordinarily made of colored glass.

Blue glass is formed by means of oxyde of cobalt.
Green by the oxyde of iron, or of copper.
Violet by the oxyde of manganese.
Red by a mixture of oxyde of iron and of copper.
Purple by the purple oxyde of gold.
White by the oxydes of arsenic and of zinc
Yellow by the oxyde of silver.

In staining glass, the coloring ingredients are mixed with water, or some other fluid vehicle, by means of which they are spread over the surface of a plate of glass, and when dry, are exposed to such a degree of heat, as by experience has been found to be sufficient. The color is then rubbed off from the surface of the glass, to which it does not adhere; and those parts of the plate which have been thus covered are found to have acquired a permanent and transparent tinge or stain, doubtless from some particles of the color having been absorbed, and fixed in the pores of the glass.

In all the compositions for staining glass, silver, in some form or other, enters as an essential ingredient.

Preparations of Silver. — Take two or three ounces of pure nitric acid; dilute it with three times its bulk of distilled water; put it into a Florence flask, or any other convenient glass vessel, and add to it refined silver, by small pieces at a time, till the acid, though kept at a warm temperature, refuses to dissolve any more. After standing quiet for some hours, pour off the clear liquor in a clean ground stoppered phial, and label it *Nitrate of Silver.*

No. 1.—Dissolve common salt in water, and add nitrate of silver drop by drop, till it ceases to occasion any precipitate; there will thus be obtained a heavy white curd-like substance, which must be well washed in hot water, and dried; by exposure to light, it becomes of a dull purple color. It is known by the name of muriate of silver, or *luna cornea.*

No. 2.—Dissolve subcarbonate of soda in water, and add nitrate of silver, as before described. The white precipitate thus obtained, when washed and dried, is ready for use. It is called the carbonate of silver.

No. 3.—Dissolve subcarbonate of potash in water, and proceed precisely as directed for No. 2. The white powder thus obtained is also carbonate of silver.

No. 4.—Dissolve phosphate of soda in water, and proceed as already mentioned. The precipitate thus obtained is of a yellowish color, and is called phosphate of silver.

No. 5.—Take any quantity of pure silver rolled out in thin plates, and put it into a crucible, together with some sulphur. When the crucible has been a short time on the fire, the sulphur will first melt, and then will gradually burn away with a blue flame. When the flame has ceased, add some more sulphur, and proceed as before; then take the silver out, and heat it red in a muffle; it will now be white, and very brittle; and after having been reduced to powder in a mortar, is fit for use.

No. 6.—Take any quantity of a dilute solution of nitrate of silver, and put into it a stick of metallic tin; warm it a little, and the silver will be precipitated in the form of metallic leaves on the surface of the tin. Scrape it off, wash it in warm water, dry it, and grind it in a mortar.

No. 7.—Take any quantity of nitrate of silver, and put into it a piece of copper plate; then proceed precisely as in No. 6.

The foregoing preparations of silver mixed with other ingredients, in the proportion about to be described, compose all the varieties of pigment which are requisite for staining glass.

YELLOW.

	Parts by Weight.
Take silver No 2	1
Yellow lake	1

Mix the ingredients and grind them well, with oil of turpentine: lay it on thin.

Take silver No. 1	1
White clay precipitated from a solution of alum by subcarbonate of soda	3
Oxalate of iron, prepared by precipitating a clear solution of sulphate of iron by oxalate of potash	3
Oxyde of zinc	2

Let the silver be ground first in water with the oxyde of zinc, and then with the other ingredients.

This is intended for floating on thick.

Take silver No. 3	1
Yellow lake	1

Grind them in spirits of turpentine and oil, and lay the mixture on very thin.

Take silver No. 4	1
Yellow lake	1
White clay	½

Grind them in spirit of turpentine and oil, and lay the mixture on thin.

ORANGE.

Take silver No. 6	1
Venetian red and yellow ochre, equal parts, washed in water, and calcined red	2

Grind the ingredients in spirits of turpentine, with thick turpentine, and lay the mixture on thin.

Take silver No. 7	1
Venetian red and yellow ochre	1

Grind in turpentine and oil, &c. as the foregoing. If entire panes of glass are to be tinged orange, the proportion of ochre may be greatly increased. The depth of the tinge depends in some measure on the heat of the furnace, and on the time that the glass is exposed to it, which, though easily learned by experience, cannot be made the subject of precise rules.

RED.

Take silver No. 5	1
Brown oxyde of iron, prepared in heating scales of iron, then quenching them in water, reducing them to a fine powder, and, lastly, calcining it in a muffle	1

Grind the ingredients with turpentine and oil, and lay the mixture on thick.

Take of antimonial silver, prepared by melting together one part of silver and two parts of crude antimony, and pulverizing the mass	1
Calcotha	1

Grind the ingredients in turpentine and oil, and lay the mixture on thick.

Take of antimonial silver, prepared as above .. 1
Venetian red and yellow ochre, of each 1
Grind, &c. as before.

When the whole panes of glass are to be tinged, the proportions of ochre and colcotha may be increased, and the ingredients should be ground in water.

On laying on the color.—The method practised by many stainers of glass is to draw an outline in Indian ink, or in a brown color, ground with turpentine and oil, and then to float on the color thick, having previously ground it with water. But in this way of proceeding, it is very subject either to flow over, or to come short of the outline, and thus render the skill of the draughtsman of little effect.

Another method is to draw the pattern in Indian ink, and having ground the color as fine as possible in spirits of turpentine, to add a little oil of lavender, and to cover the outline entirely with this composition.

When it has become dry, work out the color with the point of a stick and a knife from those parts that are not intended to be stained; the most delicate ornaments and most intricate designs may thus be executed with exactness and precision.

If the color is required to be laid on so thick that the outline would not be visible through it, let the color be first laid on as smoothly as possible, and when it has become dry, draw the outline upon it, with vermillion water-color, and work out the design as before.

Besides the precision acquired by the above method, it enables the artist to apply different shades in the same design; whereas the old method of floating only communicates a uniform tint to the whole pattern.

The artist should contrive to charge his furnace with pieces, the color of which is ground in the same vehicle, and not to mix in the same burning, some colors ground in turpentine and some ground in water. The pieces must also be very carefully dried, and must be placed in the furnace when this latter is moderately warm.

To gild glass.—Take of fine gold in grains one part, and pure mercury eight parts: warm the mercury, and then add the gold, previously making it red hot. When the gold is perfectly dissolved, pour the mixture into cold water, and wash it well. Then press out the superfluous mercury through linen, or soft leather, and the mercury which runs through (as it retains some gold) may be reserved for the next opportunity.

The amalgam which remains in the leather is to be digested in warm aqua-fortis, which will take up the mercury, but will leave the gold in the form of an extremely fine powder. This powder, when washed and dried, must be rubbed up with one third of its weight of mercury, then mix one grain of this amalgam with three grains of gold flux, which is to be applied in the usual manner. The burning, upon which much of the success of the above depends, will form the subject of a future paper.

APARTMENTS LIGHTED BY GALVANISM, AND MACHINERY MOVED BY ELECTRO-MAGNETISM.

BY DR. JACOBI.

During the last winter I frequently illuminated my saloon, which is of considerable size, by Drummond's light. The mixed gases were obtained in sufficient quantities, that is to say, at the rate of three or four cubic feet per hour, by decomposing dilute sulphuric acid (specific gravity 1·33) between poles of platina by a constant battery of a particular construction. I only passed the gas through a glass tube filled with chloride of calcium, and there was neither gasometer nor any other provision for it. As soon as the voltaic current was closed, the jet might be lighted, and the flame then burnt tranquilly, and of the same intensity for any length of time. The construction and manipulation of the battery, though extremely perfect, was still a little embarrassing. At present, a battery, with a decomposing apparatus which will produce from three to four cubic feet of gas per hour, occupies the space of ten inches by eight inches, and is about nine inches in height. Behold certainly a beautiful application of the voltaic battery.

In the application of electro-magnetism to the movement of machines, the most important obstacle always has been the embarrassment and difficult manipulation of the battery. This obstacle exists no longer. During the past autumn, and at a season already too advanced, I made the first experiment in navigation on the Neva, with a ten-oared shallop furnished with paddle-wheels, which were put into motion by an electro-magnetic machine. Although we journeyed during entire days, and usually with ten or twelve persons on board, I was not well satisfied with this first trial, for there were so many faults of construction and want of insulation in the machines and battery, which could not be repaired on the spot, that I was terribly annoyed. All these repairs and important changes being accomplished, the experiments will shortly be recommenced. The experience of the past year, combined with the recent improvements of the battery, give as the result, that to produce the force of one horse (steam-engine estimation) it will require a battery of 20 square feet of platina distributed in a convenient manner, but I hope that from eight to ten square feet will produce the effect. I hope that within a year of this time I shall have equipped an electro-magnetic vessel of from 40 to 50-horse power.

St. Petersburg, June, 1839.

FANCY WOODS.

(*Resumed from page* 238.)

King-wood is generally used for small cabinet-works, and for borderings to those which are larger. It is extremely hard. The tree which produces it is small, as the sticks are seldom brought to this country more than five inches wide and four feet long. Its color is of a chocolate ground, with black veins; sometimes running into the finest lines, and at others more spread over the ground, as in rose-wood. The botanical name of the tree which produces this wood is not known. It comes from Brazil.

And here we should remark the exceedingly imperfect state of our knowledge with regard to the species of trees which produce the fancy woods, so extensively used in cabinet-work in this country. It might be supposed that there would be no more difficulty in determining the botanical names, and deciding the species of those foreign woods which are used in our finer sorts of furniture, and in many small articles of taste, such as Tunbridge-ware, than in pointing out that oak is used in ship building, and pine in the construction of houses; but the

contrary is the fact. The ettention of botanists who have described the productions of South America and Australasia, from which these fine woods come, has not been directed to this point; and the commercial dealers in these woods have paid no regard to it. It would be well, in this age when natural history is so much cultivated, if naturalists, and dealers in foreign timher, would combine their experience upon this subject, and supply the deficiency. No knowledge of the matter can he procured in books; and we have consulted commercial men and practical botanists, without obtaining any information that could be depended upon, though each agreed in lamenting that a subject of general interest should have been so entirely without investigation. Although no important results to science might proceed from such inquiries, it is certainly humiliating not to be able to tell with precision where those materials are naturally produced, and what species of trees produce them, with which the useful arts have surrounded our every-day life.

Beef-wood, principally used in forming borders to work in which the larger woods are employed, is intensely hard and extremely heavy. Its color is of a pale red, not so clouded as mahogany. The timber arrives in this country in logs of about nine feet long by thirteen or fourteen inches wide. The tree which produces it is not known in botanical description, but it is a native of New Holland.

Tulip-wood would appear to be the produce of a tree, little exceeding the character of a shrub, for it arrives here in sticks of about five inches diameter, seldom more than four feet in length. It is very hard, and of a clouded red and yellow color. Its principal use is in bordering; though it is employed in smaller articles, such as caddies and ladies' work-tables.

Zebra-wood is the produce of a large tree, and we receive it in logs of two feet wide. It is a cheap wood, and is employed in large work, as tables. The color is somewhat gaudy, being composed of brown on a white ground, clouded with black, and each strongly contrasted, as its name imports, derived, as it is, from the colors of the zebra.

Coromandel-wood is used in large works, like zebra and rose-wood. It is inferior to rose-wood in the brilliancy and divisions of its colors, having a dingy ground, and sometimes running into white streaks. The tree which produces it is of a large size.

Satin wood is well known for its brilliant yellow color, with delicate glowing shades. It is now not much used in cabinet work. The timber arrives here in logs of two feet wide, and seven or eight feet long.

Sandel-wood is of a light brown color, with brilliant waves of a golden hue, not unlike the finest Honduras mahogany. It is about the same size as satin-wood.

Amboyna-wood is now very much used in cabinet work. It is of various colors; and the shades are generally small. It arrives in logs of two feet wide.

Snake-wood is extremely hard, of a deep red color, with black shades. It is principally used for bordering and small work.

Hare-wood something resembles satin-wood in the arrangement of its waves, but its color is different, being of a light brown ground,

Botany Bay Oak forms very beautiful furniture. The ground is a uniform brown, with large dark blotches.

Ebony.—Of the several woods bearing this name, here are the African cliff ebony, which is black, with a white spot; and the spotted ebony, a very beautiful wood, and extremely hard, (more so than the common ebony,) of which the ground is black, with brown and yellow spots.

Acker-wood is the produce of a large tree, and is of a cinnamon color. *Canary-wood* is of a golden yellow. *Purple-wood* is of a purple color, without veins. This appears to be the produce of a thorn of tropical countries, being only four inches wide. These three woods are but little used in furniture, but are employed in mosaic floors. *Bird's-eye Maple*, (its appearance is described in its name,) which has also been so employed, is a narrow and long wood.

Calamander-wood. There is a very beautiful wood of this name growing in the island of Ceylon, which, when wrought into furniture, surpasses, we think, in appearance any other we ever saw. The wood is very hard and heavy, and of singularly remarkable variety and admixture of colors. It is very difficult to describe this—nay impossible to convey to those who have not seen it an idea of the manner in which the shades run into one another. The most prevailing of these is a fine chocolate color, now deepening almost into absolute black, now fading into a medium between fawn and cream colors. In some places, however, the latter tint is placed in more striking, though never quite in sudden contrast with the richest shades of the brown. The variations are sometimes displayed in clustering mottles, sometimes in the most graceful streaks. There is not, however, anything in the least gaudy or fantastic in the general result. It certainly arrests the eye —but this is from the rich beauty of the intermingled colors, not from any undue showiness.

This wood takes a very high polish. It is wrought into chairs, and, particularly, into tables. The tree grows to the usual size of a forest-tree, the leaves are large, and shaped like the figure of a club on a playing-card.

Partridge, *Leopard*, and *Porcupine* woods, are very rarely used. Their names are derived from a supposed similarity of their colors to those of the animals whose denominations they bear.

(*Continued on page* 286.)

THE GYMNOTUS, OR ELECTRICAL EEL.

BY PROFESSOR FARADAY, F.R.S, &c.

WONDERFUL as are the laws and phenomena of electricity when made evident to us in inorganic or dead matter, their interest can bear scarcely any comparison with that which attaches to the same force when connected with the nervous system and with life; and though the obscurity which for the present surrounds the subject, may for the time also veil its importance, every advance in our knowledge of this mighty power in relation to inert things, helps to dissipate that obscurity, and to set forth more prominently the surpassing interest of this very high branch of physical philosophy. We are indeed but upon the threshold of what we may, without presumption, believe man is permitted to know of this matter; and the many eminent philosophers who have assisted in making this subject known, have, as is very evident in their writings, felt up to the latest moment that such is the case.

A Gymnotus has lately been brought to this country by Mr. Porter, and purchased by the proprietors of the Gallery in Adelaide Street; they immediately most liberally offared me the liberty of experimenting with the fish for scientific purposes; they placed it for the time exclusively at my disposal, only desiring me to have a regard for its life and

health. I was not slow to take advantage of their wish to forward the interests of science, and with many thanks accepted their offer. With this Gymnotus, having the kind assistance of Mr. Bradley of the Gallery, Mr. Gassiot and occasionally other gentlemen, as Professors Daniell, Owen, and Wheatstone, I have obtained every proof of the identity of its power with common electricity.

The fish is forty inches long. It was caught about March, 1838; was brought to the Gallery on the 15th of August, but did not feed from the time of its capture up to the 19th of October. From the 24th of August, Mr. Bradley nightly put some blood into the water, which was changed for fresh water next morning, and in this way the animal perhaps obtained some nourishment. On the 19th of October it killed and eat four small fish; since then the blood has been discontinued, and the animal has been improving ever since, consuming upon an average one fish daily. The fish eaten were gudgeons, carp, and perch.

I first experimented with it on the 3rd of September, when it was apparently languid, but gave strong shocks when the hands were favorably disposed on the body. The experiments were made on four different days, allowing periods of rest from a month to a week between each. His health seemed to improve continually, and it was during this period, between the third and fourth days of experiment, that he began to eat.

Beside the hands two kinds of collectors were used. The one sort consisted each of a copper rod fifteen inches long, having a copper disc one inch and a half in diameter brazed to one extremity, and a copper cylinder to serve as a handle, with large contact to the hand, fixed to the other, the rod from the disc upwards being well covered with a thick caoutchouc tube to insulate that part from the water. By these the states of particular parts of the fish whilst in the water could be ascertained.

The other kind of collectors were intended to meet the difficulty presented by the complete immersion of the fish in water; for even when obtaining the spark itself I did not think myself justified in asking for the removal of the animal into air. A plate of copper, eight inches long by two inches and a half wide, was bent into a saddle shape, that it might pass over the fish, and inclose a certain extent of the back and sides, and a thick copper wire was brazed to it, to convey the electric force to the experimental apparatus; a jacket of sheet caoutchouc was put over the saddle, the edge projecting at the bottom and the ends; the ends were made to converge so as to fit in some degree the body of the fish, and the bottom edges were made to spring against any horizontal surface on which the saddles were placed. The part of the wire liable to be in the water was covered with caoutchouc.

Shock.—The shock of this animal was very powerful when the hands were placed in a favorable position, *i. e.* one on the body near the head, and the other near the tail; the nearer the hands were together within certain limits the less powerful was the shock. The disc conductors conveyed the shock very well when the hands were wetted and applied in close contact with the cylindrical handles; but scarcely at all if the handles were held in the dry hands in an ordinary way.

Galvanometer.—Using the saddle conductors applied to the anterior and posterior parts of the Gymnotus, a galvanometer was readily affected. It was not particularly delicate; for zinc and platina plates on the upper and lower surface of the tongue did not cause a permanent deflection of more than 25°; yet when the fish gave a powerful discharge the deflection was as much 30°, and in one case even 40°. The deflection was constantly in a given direction, the electric current being always from the anterior parts of the animal through the galvanometer wire to the posterior parts. The former were therefore for the time externally positive, and the latter negative.

Making a Magnet.—When a little helix containing twenty-two feet of silk wire wound on a quill was put into the circuit, and an annealed steel needle placed in the helix, the needle became a magnet, and the direction of its polarity in every case indicated a current from the anterior to the posterior parts of the Gymnotus through the conductors used.

Chemical decomposition. — Polar decomposition of a solution of iodide of potassium was easily obtained. Three or four folds of paper moistened in the solution were placed between a platina plate and the end of a wire also of a platina, these being respectively connected with the two saddle conductors. Whenever the wire was in conjunction with the conductor at the fore part of the Gymnotus, iodine appeared at its extremity; but when connected with the other conductor none was evolved at the place on the paper where it before appeared. So that here again the direction of the current proved to be the same as that given by the former tests.

By this test I compared the middle part of the fish with other portions before and behind it, and found that the conductor A, which being applied to the middle was negative to the conductor B applied to the anterior parts, was, on the contrary, positive to it when B was applied to places near the tail. So that within certain limits the condition of the fish externally at the time of the shock appears to be such, that any given part is negative to other parts anterior to it, and positive to such as are behind it.

Spark.—The electric spark was obtained thus. A good magneto-electric coil, with a core of soft iron wire, had one extremity made fast to the end of one of the saddle collectors, and the other fixed to a new steel file: another file was made fast to the end of the other collector, One person then rubbed the point of one of these files over the face of the other, whilst another person put the collectors over the fish, and endeavoured to excite it to action. By the friction of the files contact was made and broken very frequently; and the object was to catch the moment of the current through the wire and helix and by breaking contact *during the current* to make the electricity sensible as a spark.

The spark was obtained four times, and nearly all who were present saw it. That it was not due to the mere attrition of the two files was shown by its not occurring when the files were rubbed together, independently of the animal. Since then I have substituted for the lower file a revolving steel plate, cut file-fashion on its face, and for the upper file wires of iron, with all of which the spark was obtained.

Such were the general electric phenomena obtained from this Gymnotus whilst living and active in its native element. On several occasions many of them were obtained together; thus a magnet was made, the galvanometer deflected, and perhaps a wire heated, by one single discharge of the electric force of the animal.

I think a few further but brief details of expe-

riments, relating to the quantity and disposition of the electricity in and about this wonderful animal, will not be out of place in this short account of its powers.

When the shock is strong, it is like that of a large Leyden battery charged to a low degree, or that of a good voltaic battery of perhaps one hundred or more pairs of plates, of which the circuit is completed for a moment only. I endeavoured to form some idea of the quantity of electricity by connecting a large Leyden battery with two brass balls, above three inches in diameter, placed seven inches apart in a tub of water, so that they might rapresent the parts of the Gymnotus to which the collectors had been applied; but to lower the intensity of the discharge, eight inches in length of six-fold thick wetted string were interposed elsewhere in the circuit, this being found necesary to prevent the easy occurrence of the spark at the ends of the collectors, when they were applied in the water near to the balls, as they had been before to the fish. Being thus arranged, when the battery was strongly charged and discharged, and the hands put into the water near the balls, a shock was felt, much resembling that from the fish; and though the experiments have no pretension to accuracy, yet as the tension could be in some degree imitated by reference to the more or less ready production of a spark, and after that the shock be used to indicate whether the quantity was about the same, I think we may conclude that a single medium discharge of the fish is at least equal to the electricity of a Leyden battery of fifteen jars, containing 3,500 square inches of glass coated on both sides, charged to its highest degree. This conclusion respecting the great quantity of electricity in a single Gymnotus shock, is in perfect accordance with the degree of deflection which it can produce in a galvanometer needle, and also with the amount of chemical decomposition produced in the electrolyzing experments.

Great as is the force in a single discharge, the Gymnotus, as Humboldt describes, and as I have frequently experienced, gives a double and even a triple shock; and this capability of immediately repeating the effect with scarcely a sensible interval of time, is very important in the considerations which must arise hereafter respecting the origin and excitement of the power in the animal.

As, at the moment when the fish wills the shock, the anterior parts are positive and the posterior parts negative, it may be concluded that there is a current from the former to the latter through every part of the water which surrounds the animal, to a considerable distance from its body. The shock which is felt, therefore, when the hands are in the most favorable position is the effect of a very small portion only of the electricity which the animal discharges at the moment, by far the largest portion passing through the surrounding water. This enormous external current must be accompanied by some effect within the fish equivalent to a current, the direction of which is from the tail towards the head, and equal to the sum of all these external forces.

It is evident from all the experiments as well as from simple considerations, that all the water and all the conducting matter around the fish, through which a discharge circuit can in any way be completed, is filled at the moment with circulating electric power; and this state might be easily represented generally in a diagram by drawing the lines of inductive action upon it; in the case of a Gymnotus, surrounded equally in all directions by water, these would resemble generally, in disposition, the magnetic curves of a magnet, having the same straight or curved shape as the animal, *i. e.* provided he, in such cases employed, as may be expected, his four electric organs at once.—*Philosophical Trans.* 1839.

MISCELLANIES.

Effects of Mushrooms on the Air.—According to Dr. Mariet mushrooms produce very different effects upon atmospheric air, from those occasioned by green plants under the same circumstances: the air is promptly vitiated, both by absorbing oxygen to form carbonic acid at the expense of the vegetable carbon, or by the evolution of carbonic acid immediately formed; the effects appear to be the same both day and night.

If fresh mushrooms be kept in an atmosphere of pure oxygen gas, a large proportion of it disappears in a few hours. One portion combines with the carbon of the vegetable to form carbonic acid, and another is fixed in the plant, and is replaced by azotic gas disengaged from the mushrooms.

When fresh mushrooms are placed for some hours in an atmosphere of azotic gas, they produce but little effect upon it. A small quantity of carbonic acid is disengaged, and in some cases a little azote is absorbed.—*Journal de Pharm. Mars*, 1839.

A River Scythe.—A method has been resorted to for the purpose of cutting the weeds on the upper Witham of sewers which has proved of great utility, and is deserving of being extensively adopted. It is this; several scythe blades are rivetted together in one length, so as to reach across the river, and also to curve down towards the bed of it. The elasticity of the scythes, and their united length, naturally cause the curvature to take the proper adaptation, and fit the bed; but there are also some weights added, to assist in keeping the implement at a proper depth: besides which it is requisite to let the edge be always horizontal; a broad piece of iron is therefore rivetted at each extremity, at right angles, and to these ends ropes are attached. Three men on each side of the river draw the apparatus upwards, thus meeting the weeds as they are bent downwards by the current; by proceeding thus the weeds are cut close to the roots. Four miles a day can be cut and cleared, but it is necessary to have four men on each side the river to haul and relieve each other, and eight men to follow with rakes.—*Stamford Mercury.*

Lengthening of a Steamer.—A curious operation lately took place in Chatham dockyard, that of lenthening the Gleaner steam-vessel, which had been taken into dock for that purpose. She was sawn in two a little more than one-third of her length from her stern, and ways were laid from the fore-part of her to tread on, the purchase falls were rove, and brought to two capstans, and the order being given by the master shipwright, the men hove away, and in five minutes the fore section was separated from the after part, a distance of 18 feet. The space between will now be filled up by new timber. There is no record of any ship or vessel having been lengthened in this dockyard before the Gleaner.

Typeface.—Under this title a M. Pellet, of Bordeaux, has, it is said, formed, a material with which he can take perfect casts of the human face, without inducing that rigidity and contortion which are caused by the application of plaster.

To give variegated Colors to Flame and Fireworks.—It is much to be wished, that, for the sake of variety different colors could be given to fireworks

at pleasure; but though we are acquainted with several materials which communicate to flame various colors, it has hitherto been possible to introduce only a very few colors into that of gunpowder.

To make white fire, the gunpowder must be mixed with iron, or rather steel filings.

To make red fire, iron-sand must be employed in the same manner.

As copper filings, when thrown into a flame, render it green, it might be concluded, that if mixed with gunpowder, it would produce a green flame; but this experiment does not succeed. It is supposed that the flame is too ardent, and consumes the inflammable part of the copper too soon. But it is probable that a sufficient number of trials have not yet been made; for is it not possible to lessen the force of gunpowder in a considerable degree, by increasing the dose of the charcoal?

Camphor mixed with the composition, makes the flame to appear of a pale white color.

Respings of ivory give a clear flame of a silver color, inclining a little to that of lead; or rather a white dazzling flame.

Greek pitch produces a reddish flame, of a bronze color.—Black pitch, a dusky flame; like a thick smoke which obscures the atmosphere.—Sulphur, mixed in a moderate quantity, makes the flame appear blue.—Sal-ammoniac and verdigris give a greenish flame.—Raspings of yellow amber communicates to the flame a lemon color.—Crude antimony gives a russet color.

Copying Oil Paintings.—The German papers state that M. Leipmann, of Berlin, has invented a machine for obtaining copies of oil-colored paintings. It is further said, that the inventor produced with his machine, in one of the rooms of the Royal Museum, at Berlin, 110 copies of Rembrandt's portrait, painted by himself. M. Leipmann offers these copies for sale at a louis d'or each.

To take Impressions from Leaves.—Take green leaves of trees or flowers, and lay them between the leaves of a book till they are dry. Then mix up some lamp-black with drying oil, and make a small dabber of some cotton wrapped up in a piece of soft leather. Put your color upon a tile, and take some on your dabber. Laying the dried leaf flat upon a table, dab it very gently with the oil color, till the veins of the leaf are covered; but you must be careful not to dab it so hard as to force the color between the veins. Moisten a piece of paper, or rather have a piece laying between several sheets of moistened paper for several hours, and lay this over the leaf which has been blackened. Press it gently down, and then subject it to the action of a press, or lay a heavy weight upon it, and press it down very hard. By this means you obtain a very beautiful impression of the leaf and all its veins; even the minutest will be represented in a more perfect manner than they could be drawn with the greatest care. These impressions may also be colored in the same manner as prints.*

New Balloon.—M. Garnerin is reported to have made some progress in the direction of balloons through the air, by supplying them with sails somewhat in the form of those of windmills.

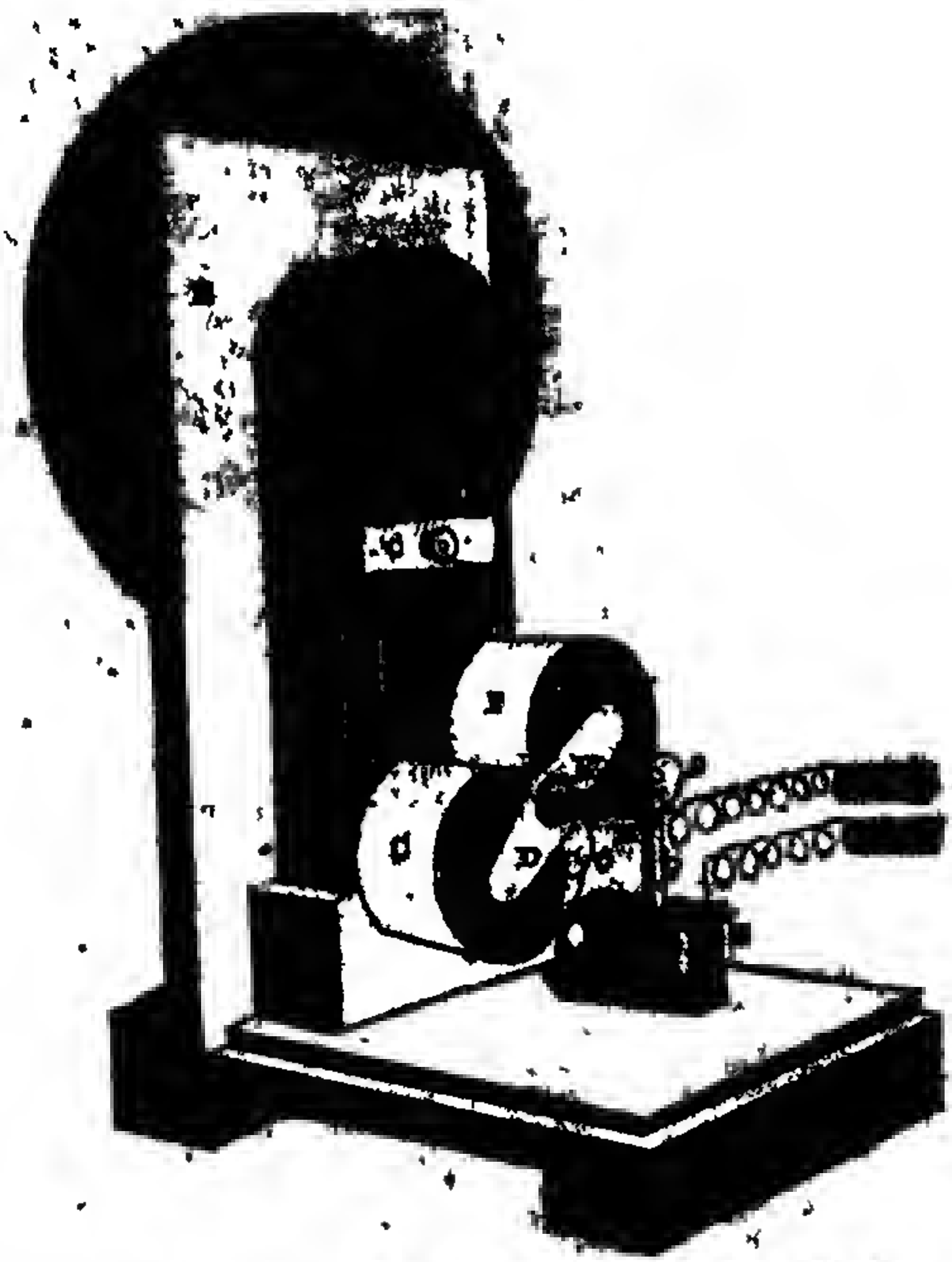
Rain-Guages.—It was acknowledged at the Birmingham meeting that small reliance could be placed on rain-guages in elevated situations, where they were exposed to winds and storms. Unless something of a superior construction be devised, we must be content with the average accuracy of the present instruments, though precision is so important to all meteorological observations.

New Fossil Species.—M. Eudes Deslongchamps has lately published a memoir on a fossil Saurian, discovered near Caen in 1835, which he proposes to name *Pœkilopleuron Bucklandi* (*q. d.* varied-ribbed.) This animal, which must have been at least from 25 to 30 feet long, must have been intermediate to the crocodiles and lizards. It approximates nearly to the Megalosaurus; nevertheless marked differences in the form of the vertebræ and of the femura, the only bones of the megalosaurus yet known to us and described, have induced M. Deslongchamps to form another genus of this new animal, characterized by the number and diversity of its ribs. These ribs are, in fact, of different sorts: there are seven, symmetrical, curved like a chevron in the middle, and tapering off at their two extremities, at which their upper surface is channelled out. They were evidently placed on the medial line, in the thickness of the coatings of the abdomen, and resemble the osseus spines which are found in the abdominal muscles of certain lizards, as chameleons, the anolis, &c. The Pœkilopleuron had seven other pairs of ribs, or fourteen osseous parts, resembling to a certain degree the former, and which also must have been situated among muscles behind the former, but with this difference, that instead of being united on the medium line into one, they were united by means of ligaments. All the abdominal ribs were provided at their extremities with a bony process on the inner face, and attached, for about half their length, in the channel before-mentioned. The seven last pairs of ribs, with their processes, resembled nearly the smaller ribs of the crocodiles.

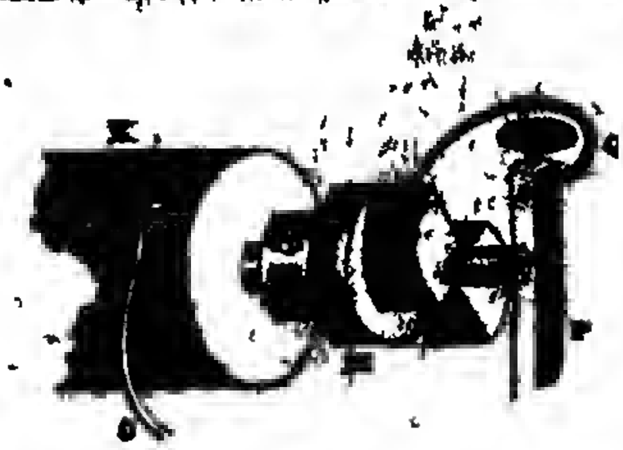
It would appear from this singular formation, that the inferior portion of the abdomen must have been very extended, and that it must have been fortified with forty-nine bony pieces.

The other portions, collected and collated by M. Deslongchamps, are caudal vertebræ, to the number of twenty-one, a great number of ribs, a pelvis, a femoral bone, a portion of the fibula, four bones of the tarsi, many phalanges, a left humerus, radius and cubicular bone. The vertebræ have the body slightly concave, both before and behind, and present charactèrs which assimilate them with those of crocodiles and of lizards, without belonging to either of these types.

Conservation of Living Plants during Long Voyages.—"Having constructed a case so that the air could not enter, by carefully fixing several bands of linen on all the joints with a glue not liable to alteration, I prepared," says M. d'Eaubonne, "with potters' clay, cow dung, and water a somewhat liquid mortar, in which I immersed the roots, having previously coated the stem; this being done, I covered them with moss and placed them in the case, filling the intervals carefully with straw, so that no friction might take place from the pitching or rolling of the vessel. I closed the case; and, after having used the same precautions for the exterior joints as for the inner ones, I had it placed in the hold of the vessel which was to carry it to the Isle of Mauritius. The vessel arrived safe, the case was disembarked and opened before the customs, and instead of dry and sapless wood as was expected to be found, trees covered with leaves and flowers, much to our surprise, were to be seen."



CLARKE'S MAGNETO-ELECTRICAL MACHINE.



MAGNETO-ELECTRICAL MACHINE.

The discovery of Professor Faraday, that a current of magnetism would produce electrical effects, and the wonderful and before unknown powers of this science displayed by his experiments, supported as they were by Mr. Forbes, at Edinburgh, who first witnessed the magnetic spark, has shown the intimate connection of the sciences of magnetism and electricity more than any other course of investigation; and rendered all who have the least pretence to class themselves among the scientific anxious to witness the spark, shock, decomposition of water, deflagration of metals, and rotatory motions produced by the magnet only, independent of that chemical action always attending galvanism. The machines capable of accomplishing this are called *Magneto-Electrical;* and vary but very slightly in their form, in some the magnets being placed horizontally, in others vertically. The following, by Mr. Clarke, of the Lowther Arcade, will show their usual and most useful structure.

Fig. 1, represents the battery of bent bar magnets, placed vertically, and resting against four adjusting screws, which pass through the mahogany backboard B; C is a bar of stout brass, having an opening in the middle, through which passes a bolt, with a screw wheel, the purpose of which is to draw the magnetic battery to the board B. By these means the battery can readily be disengaged from the machine, without taking asunder the entire apparatus, and the battery is thus also freed from that vibration which must necessarily be occasioned by the attachment of the rotating apparatus to the battery itself. D is the intensity armature, or inductor, which screws into a brass mandril, seated between the poles of the battery A; motion being communicated to it by the multiplying wheel E. This armature has two coils of fine insulated copper wire, one thousand five hundred yards long, coiled on its cylinders, the commencement of each coil being soldered to the armature D, from which projects a brass stem, (also soldered into D,) which carries the break pieces H: the break piece is made fast in what position soever is required by a small binding screw. K, a hollow brass cylinder, to which the terminations of the coils, F G, are soldered, being insulated by a piece of hard wood, attached to the brass stem. O is an iron wire spring, pressing against the hollow cylinder, K, at one end, and held in metallic contact by a nurled head screw, in the brass strap N, which is fixed to the side of the wooden block L. P, a square brass pillar, fitting into a square opening in the other brass strap N, and secured at any convenient height required. Q, a metal spring, that rubs gently on the break piece H, and held in perfect metallic contact by the nurled head screw in P. T, a piece of copper wire for connecting the two brass straps M N; then D H Q P N, are in connection with the commencements of each coil, and K O M, with the terminations. The advantages of this arrangement are that mercury is not required, as in Saxton's machine, by which much loss and inconvenience is occasioned by its being scattered about by the disc and blades. By Clarke's arrangement, the metal spring Q presses gently on the break H, consequently, the effects here are unbroken, no matter how long the machine may be required to be kept in action; this is not the only advantage it possesses, for, in the mercury, the surface is very rapidly oxidated; the oxide adheres to both disc and point, and preventing so perfect a metallic contact as that obtained by the spring and break.

To adjust the intensity conductor, the faces of the iron cylinders, that carry the coils F G, must be placed parallel to, and nearly in contact with the battery A; this can easily be done, and the battery adjusted with the greatest nicety, by means of the screws at the back of the machine; the break must then be so adjusted that the spring Q will separate from it, just at the same time that the iron cylinders of the inductor have left the poles of the magnetic battery; and, lastly, the iron wire spring O, must press gently against the hollow brass cylinder H.

In order to give the shock, the two brass conductors R S must be grasped in the hands, and one of their connecting wires put into the holes of either of the brass slips M or N, and the other wire into the hole at the end of the brass stem that carries the break H. M N must then be connected by T, and on turning the wheel a violent shock will be felt by the person holding R S. When the wheel is rapidly turned, the quick succession of shocks is absolutely intolerable, and produces so violent an effect on the muscles of the arm, that they contract, and cause the hands to clench the conductors involuntarily, and the person is left at the mercy of the operator, it being quite impossible to let go: the better way of taking the shock is, therefore, to plunge R S into two separate basins of salt and water, and immerse a hand in each. If the two connecting wires of R S are put in M N, the shock is not so powerful. The shock may be modified in different ways, by turning the wheel E very slowly, or increasing the distance between the battery A and the armature D; or, by making the break H separate from the spring Q when the armature D is horizontal.

Fig. 2 represents the parts of the armature of their actual size, the letters are the same as in Fig. 1.

PLANTS USED AS TEA.

The plants used as tea are as widely separated from each other as the countries themselves are remote. In Mexico and Guatimala the leaves of the *Psoralea glandulosa* are generally used as tea; and in New Granada the *Alstonia theæformis* of Mutis, the *Symplocos Alstonia* of Humboldt and Bonpland, affords a tea not inferior to that of China. Farther to the north, on the same continent, a very wholesome tea is made from the leaves of the *Gaultheria procumbens* and *Ledum latifolium.* This last is vulgarly called Labrador tea, and its use was first made known by the late Sir Joseph Banks. The most famous of all American teas, however, is the tea of Paraguay, of which large quantities are annually imported into Peru, Chili, and the States of Buenos Ayres, and the use of it is so universal in South America, that the inhabitants have always some of this tea ready prepared, whether engaged in occupations at home or in the fields, and no person departs on a journey without being provided with a quantity of the herb. It is made by merely pouring warm water on the leaves, and is sipped, through a silver or glass tube, from a small vessel, called a matè pot, which is carried in the hand, or, should the person be on horseback, or engaged in any occupation requiring the use of his hands, it is suspended from the neck by means of a small chain.

It is frequently mixed with a little lemon-juice, and is used either with or without sugar. The Paraguay tea is the more remarkable, from its being the produce of a species of holly, a genus hitherto considered as deleterious. It is described and figured under the name of *Ilex Paraguensis*, in an Appendix to the second volume of Mr. Lambert's work on the genus *Pinus*, and is noticed by M. Auguste St. Hilaire in the "Memoires de Museum," under the name of *Ilex Mate*, and by Drs. Spix and Martius, in their Brazilian Travels, under that of *Ilex Gongonha*. It has an extensive geographical range, being found in the extensive woody regions of Paraguay, watered by the Parana, the Ypane, and Jejni, in the province of the Minas Geraes, and other districts of Brazil; and it appears to have been found in Guiana by M. Martin, as there are numerous specimens in his herbarium. We must believe these specimens to have been collected in the mountainous district, otherwise it would be impossible to reconcile the idea of the same plant being found in so different a latitude. The tree is about the size of the orange-tree, to which it bears considerable resemblance in its habit and leaves. The flowers are white, disposed in small cymes in the axils of the leaves. They are tetrandrous, and are succeeded by scarlet berries, like those of the common holly. The leaves, whether fresh or dried, are destitute of smell; but, on a little warm water being poured upon them, they exhale an agreeable odour. In New Holland the leaves of *Correa alba* make very good tea. The inhabitants of those barren and remote islands denominated the Kurile Isles, in the Sea of Kamtschatka, prepare a tea from an undescribed species of *Pedicularis*, named by Professor Pallas in his herbarium, *Pedicularis lanata*. It is unnecessary to take notice of all the aromatic herbs of the order *Labiatæ* used as tea in different countries: the object is to show that teas are afforded by plants very remotely separated from each other in point of affinity. But while on the subject of teas, it may be interesting to observe, that the common black Chinese teas consist chiefly of the old leaves of the *Thea viridis*, mixed with those of the *Camellia Sasanqua* or *oleifera*, and sometimes fragments of the leaves of the *Olea fragrans*; and that the finest teas, whether green or black, appear to be produced by the *Thea Bohea*, the quality and color depending solely on the age of the leaves, and the mode of preparing them. We have never been able to detect, in those teas said to be adulterated, either willow or aloe leaves, or any thing else of British growth. It is probable that the leaves of the species of *Camellia* before mentioned may have been taken for sloe leaves.

ETCHING IVORY.

For etching ivory, a ground made by the following receipt is to be applied to the polished surface:—Take of pure white wax, and transparent tears of mastic, each an ounce; asphalte, half an ounce. The mastic and asphalte having been separately reduced to fine powder, and the wax being melted in an earthenware vessel over the fire, the mastic is to be first slowly strewed in and dissolved by stirring; and then the asphalte in like manner. This compound is to be poured out into lukewarm water, well kneaded, as it cools, by the hand, into rolls or balls about one inch in diameter. These should be kept wrapped round with taffety. If white rosin be substituted for the mastic, a cheaper composition will be obtained, which answers nearly as well; 2 oz. asphalte, 1 oz. rosin, ½ oz. white wax; being good proportions. Callot's etching ground for copper plates, is made by dissolving with heat 4 oz. of mastic in 4 oz. of very fine linseed oil; filtering the varnish through a rag, and bottling it for use.

Either of the two first grounds being applied to the ivory, the figured design is to be traced through it in the usual way, a ledge of wax is to be applied, and the surface is to be then covered with strong sulphuric acid. The effect comes better out with the aid of a little heat; and by replacing the acid, as it becomes dilute by absorption of moisture, with concentrated oil of vitriol. Simple wax may be employed instead of the copper-plate engraver's ground; and strong muriatic acid instead of sulphuric. If an acid solution of silver or gold be used for etching, the design will become purple or black, on exposure to sunshine. The wax may be washed away with oil of turpentine. Acid nitrate of silver affords the easiest means of tracing permanent black lines upon ivory.

ORNAMENTS FOR MOULDINGS. &c.

BY J. ESQUILANT.

The ornaments are flowers, foliage, and fruit, arranged in wreaths or groups, and copied from nature with sufficient accuracy to be at once recognizable. They are entirely relieved from the plain surface on which they are placed, resembling in their general appearance the highly raised carvings in wood by Gibbons, and other artists of the last century.

Metal moulds of separate leaves, and of the various petals and other pieces of which flowers are composed, are to be prepared. A piece of leather, of the required thickness, is to be cut to the proper form and size of the intended leaf, and is then to be soaked for a day or two in a solution of rosin in common oil of turpentine. When the leather is fully impregnated with the liquor, it is to be taken out and wiped, and then cold-pressed in the mould with sufficient force to give it the intended figure; it hardens as it dries by the evaporation of the essential oil, and, when once dry, retains its form without warping afterwards on exposure to damp or draught. The separate pieces are then put together by ties and glue, and finally are covered with a coat of paint, varnish, or gilding. For representing fruit, employ sawdust, ground in a mill to fine powder, and mixed up to the consistence of putty, with glue and a little rosin and turpentine. This composition may be moulded either by hand, or by pressure into moulds: when dry, it has the appearance, and more than the hardness, of wood. For flowers with thin petals, such as roses and carnations, he often uses rolled zinc, shaped to the proper figure by compressing the parts separately in a mould, and then cementing them together. Leather prepared as above described, has the following advantages over wood or *papier-maché* with a degree of hardness at least equal to either of these substances, it is so tough as not to be liable to chip by a blow, and may therefore be made to stand out from the surface to which it is applied in the highest relief, without the risk of damage; and the cost, all things being considered, is very moderate.—*Trans. Society of Arts.*

CHEMICAL NOMENCLATURE.

(Resumed from page 232.)

OLD NAMES.	NEW NAMES.
Acetous Salts	Acetites.
Acid of Vitriol, Fuming	Sulphurous Acid.
Acid of Alum Acid of Vitriol Acid, Vitriolic Acid of Sulphur	Sulphuric Acid.
Acid of Nitre, Fuming	Nitrous Acid.
Acid of Nitre Acid of Saltpetre	Nitric Acid
Acid of Sea Salt Acid, Muriatic Acid, Marine	Hydro-chloric Acid.
Acid, Oxymuriatic	Chlorine.
Acid, Pyrolignous	Acetic Acid.
Acid of Chalk Acid, Cretaceous Acid of Charcoal Acid, Mephitic	Carbonic Acid Gas.
Acid of Flour Spar	Fluoric Acid.
Acid of Borax	Boracic Acid.
Acid of Apples	Mallic Acid.
Acid of Sugar Acid, Saccharine	Oxalic Acid.
Acid of Lemons	Citric Acid.
Acid of Phosphorus	Phosphoric Acid.
Acid of Fat	Sebacic Acid.
Air, Dephlogisticated Air, Empyreal Air, Vital Air, Pure	Oxygen.
Air, Impure or Vitiated Air, Burnt Air, Phlogisticated	Azote, or Nitrogen.
Air, Inflammable	Hydrogen.
Air, Marine Acid Air, Muriatic Acid	Hydro-chloric Acid Gas.
Air, Oxymuriatic (Gas)	Chlorine.
Air, Hepatic Air, Fœtid, of Sulphur	Sulphuretted Hydrogen.
Air, Fixed Air, Solid, of *Hales*	Carbonic Acid Gas.
Air, Alkaline	Ammoniacal Gas.
Alkali, Concrete Volatile	Carbonate of Ammonia.
Alkali, Effervescent	Carbonated Alkalis.
Alkali, Prussian	Ferrocyanate of Potassa, &c.
Aquafortis	Nitric Acid of Commerce.
Aqua Regia	Nitric and Hydro-chloric Acid.
Aqua Reginæ	Nitro-sulphuric Acid.
Argil, or Argillaceous Earth	Alumina.
Ash, Pearl	Carbonate of Potassa (impure).
Aurum Musivum	Sulphuret of Tin.
Baldwin's Phosphorus	Nitrate of Lime.
Bezoar Mineral	Oxyde of Antimony.
Black Lead	Percarburet of Iron.
Blende	Sulphuret of Zinc.
Blue, Prussian	Hydro-cyanate of Iron.
Barilla (Kelp)	Carbonate of Soda (impure).
Borax*	Sub-borate of Soda.
Butters of the Metals	Chlorides, as of Antimony, &c.
Calces, Metallic	Metallic Oxydes.
Calomel	Proto-muriate of Mercu
Calx	Lime.
Cameleon Mineral	Nitrate of Potass, and Manganese.
Canton's Phosphorus	Phosphate of Lime.
Caustic, Lunar	Nitrate of Silver, run into Moulds.
Ceruse	Carbonate of Lead.
Chalk	Carbonate of Lime.
Charcoal, Pure	Carbon.
Cinnabar	Persulphuret of Mercury.
Colcothar of Vitriol	Brown-red Oxyde of Iron.
Copper, Acetated	Acetite of Copper.
Copperas, Green	Sulphate of Iron.
Copperas, Blue	Sulphate of Copper.
Copperas, White	Sulphate of Zinc.
Corrosive Sublimate	Perchlorate of Mercury.
Cream of Tartar	Supertartrate of Potass.
Crocus	Peroxyde of Iron.
Cubic Nitre	Nitrate of Soda.
Digestive Salt	Hydro-chlorate of Potass.
Derbyshire Spar	Fluate of Lime.
Earth, Calcareous	Lime.
Earth, Aluminous Earth of Alum	Alumina.
Earth, Magnesian	Magnesia.
Emetic Tartar	Antimoniated Tartrite of Potassa.
Ethiops, Martial	Black Oxyde of Iron.
Ethiops, Mineral	Proto-sulphuret of Mercury.
Flint	Silica.
Flowers, Metallic	Sublimed Metallic Oxydes
Flowers of Benjamin	Gum Benzoin.
Flowers of Sulphur	Sublimed Sulphur.
Fluors	Fluates, as of Lime, &c.
Gasses, various	See Airs.
Goulard Water	Acetate of Lead in solution.
Grey Salts	Impure Potass.
Gypsum	Sulphate of Lime.
Hepars, or Sulphurs	Sulphurets, as of Potassa, &c.
James's Powder	Phosphate of Lime and Antimony.
Kermes Mineral	Hydro-sulphuret of Antimony.
Keyler's Pill	Acetate of Mercury.
Lapis Infernalis	Sticks of Caustic Potassa.
Lead, Sugar of	Peracetate of Lead.
Lime	Oxyde of Calcium.
Liquor of Libavius	Chloride of Tin.
Liquor of Flint	Silica and Potass, Fused.
Litharge	Vitrified Protoxyde of Lead.
Liver of Sulphur, Alkaline	Sulphuret of Potassa.
Loadstone	A state of Protoxyde of Iron.
Lunar Cornea (Horn Sil.)	Muriate of Silver.
Lunar Caustic	Nitrate of Silver, Fused.
Magistry of Bismuth	Proto-nitrate of Bismuth.
Magnesia Alba Magnesia Aerated	Carbonate of Magnesia.
Mother Waters	Deliquescent Saline Residue.
Muriates	Chlorides.
Nitre (or Saltpetre)	Nitrate of Potass.
Natron	An impure Carbonate of Soda.
Oil of Tartar	Deliquescent Potassa.
Orpiment	Persulphuret of Arsenic.

* Called also Tincal, under which name it is sometimes imported.

OLD NAMES.	NEW NAMES.
Oxymuriates	Chlorates.
Pearl Ash	Bicarbonate of Potass.
Phlogiston	An imaginary inflammable principle, to the combination of which *metallization* and *combustion* were ascribed. In Stahl's opinion, *charcoal* was phlogiston nearly pure; according to Scheele *hydrogen* was this principle.
Plaster of Paris	Sulphate of Lime.
Plumbago (Black Lead)	Percarburhet of Iron.
Plumbum Corneum	Chloride of Lead.
Potash, or Potass	Oxyde of Potassium.
Powder of Algaroth	Deutoxyde of Antimony.
Precipitate, Red Precipitate, *per se*	Peroxyde of Mercury.
Prussian Blue	Ferrosesquicyanuret of Iron.
Prussian Acid	Hydrocyanic Acid.
Putty Powder	Peroxyde of Tin.
Pyrites of Copper	Sulphuret of Copper.
Pyrites, Martial	Sulphuret of Iron.
Realgar	Proto-sulphuret of Arsenic
Regulus of Metals	Metallic, or pure form of Metals.
Resin of Copper	Proto-chloride of Copper.
Rust of Copper	Green Oxyde of Copper.
Rust of Iron	Oxyde and Carbonate of Iron.
Saffron of Mars	Oxyde of Iron.
Saline Draught	Citrate of Potass.
Sal-Ammoniac	Muriate of Ammonia.
Sal-Mirabile	Sulphate of Soda.
Sal-Prunella	Fused Nitrate of Potassa.
Sal-Polychrest	Sulphate of Potassa.
Sal-Enixum	Acid Sulphate of Potassa.
Salt, Common Table	Muriate of Soda.*
Salt of Chalk	Acetate of Lime.
Salt of Tartar	Subcarbonate of Potassa.
Salt, Sedative	Boracic Acid.
Salt, Prout's Perlated	Phosphate of Soda.
Salt of Wormwood	Carbonate of Potassa.
Salt, Vegetable	Tartrite of Potassa.
Salt of Lemons (Essential) Salt of Sorrel	Quadroxalate of Potassa.
Salt, Febrifuge, of *Sylvius*	Muriate of Potassa.
Salt, Microcosmic	Phosphate of Soda and Ammonia.
Salts, Glauber	Sulphate of Soda.
Salts, Epsom	Sulphate of Magnesia.
Salts, Rochelle	Tartrate of Potassa and Soda.
Scheele's Green	Arsenite of Copper.
Saltpetre	Nitrate of Potassa.
Selenite (Gypsum)	Sulphate of Lime.
Silicated Potass	Flint Fused with much Potass.
Smelling Salts	Carbonate of Ammonia.
Spar, Calcareous	Crystallized Carbonate of Lime.
Spar, Fluor	Fluate of Lime.
Spar, Ponderous	Sulphate of Baryta.
Spirit, Ardent Spirit of Wine	Alcohol.
Spirit of Nitre	Nitric Acid.
Spirit of Nitre, Fuming	Nitrous Acid.

* Called Muriate of Soda when in solution, &c., and Chloride of Sodium when perfectly dry.

OLD NAMES.	NEW NAMES.
Spirit of Mindererus	Acetate of Ammonia.
Spirit of Salt	Hydro-chloric Acid.
Spirit of Sal-ammoniac	Ammonia.
Spirit of Vitriol	Sulphuric Acid.
Spirit of Sulphur	Sulphuric Ether.
Spiritus Rector	Aroma.
Speltre	Zinc, (impure from an admixture of Lead and Sulphur.)
....	A compound of Nickel and Arsenic.
Sweet Spirit of Nitre and Dulcified ditto	Nitric Ether.
Sublimate, Corrosive	Perchlorate of Mercury.
Sugar of Lead	Peracetate of Lead.
Tartar	Acidulous Tartrite of Potassa.
Tartar, Emetic	Antimoniated ditto.
Tartar, Vitriolated	Sulphate of Potassa.
Tartar, Cream of	Super-tartrate of ditto.
Tartars	Tartrites.
Turbith, Mineral	Subsulphate of Mercury.
Verdigris or Rust of Copper, exposed to air	Green Oxyde of Copper.
Verdigris, Prepared	Acetite of Copper.
Verdigris, Distilled	Crystallized Acetite of Copper.
Vinegar, Distilled Vinegar, Radical	Acetous Acid.
Vinegar of Wood Vinegar, White	Pyrolignous Acid.
Vitriol, Blue or Roman	Sulphate of Copper.
Vitriol, Green Vitriol, Martial	Sulphate of Iron.
Vitriol, White	Sulphate of Zinc.
Vitriols	Sulphates.
Water, Acidulated Water, Soda	Water impregnated with Carbonic Acid Gas.
Water, Hepatic	Sulphuretted Hydrogen in Water.
White Arsenic	Arsenious Acid.
Zaffre	Oxyde of Cobalt.
Zinc, Flowers of, or Philosophical Wool	Oxyde of Zinc.

Ancient names of the seven common metals:—

Gold	was called the	Sun.
Silver	,,	Moon.
Mercury		Mercury.
Copper		Venus.
Iron		Mars.
Tin		Jupiter.
Lead		Saturn.

The other metals were not known to the ancients.

MANUFACTURE OF INDIAN INK.

BY M. MERIMEE.

The best of this manufacture has a shining black fracture; its body is finely compact, and homogeneous when rubbed with water; there is not the least appearance of particles, and when diluted in much water, there is not any precipitate formed;—when dry, its surface is covered with a pellicle of a metallic appearance; when dry on the paper, it will not yield to the action of water, yet it will give way at once to that action, when it has been used and dried on marble or ivory, which proves that the alumed paper forms a strong combination with the ink.

Nothing is positively known of the method of preparing it, except what Duhalde has told us in

his "*History of China.*" The receipt which he has given, as taken from a Chinese book, is as follows :—

The makers of this ink take some of the plants, hohiang and kansang, the cloves of tchu-yiatsao-ko, and the juice of ginger; these are to be boiled in water, the decoction clarified, and then evaporated to a thick consistency: ten ounces of this electuary is then mixed with four ounces of size, made from asses' skin parchment; this mixture is then incorporated with ten ounces of smoke black, and then the whole is wrought into fine paste, which is put into moulds; these are covered up in the ashes, where they remain a longer or shorter time according to the season.

P. Duhalde, being aware that all the plants mentioned in this process, except the ginger, are unknown to our botanists, saw at once that his receipt would be useless, unless he could give some means of substituting, for the Chinese plants, those of our own country which are most analogous to them. He, therefore, on this subject, made diligent inquiries, the result of which he has published; we learn from the author, that the pods called *tchu-yiatsao-ko* are produced by a bush or shrub, and resemble those of the carob bean, except that they are smaller and nearly round. The Chinese plants inclose cells filled with a pulpy substance, of a pungent and unpleasant flavour.

Hohiang is, according to the Chinese dictionary, an aromatic medicinal plant, to which are attributed the same qualities as belong to the *sou ho;* another plant from which is extracted a balm similar to liquid storax.

Finally, the kansang is a plant used in the composition of perfumes, and is pleasing to the taste.

The processes used in the arts are always difficult to describe; yet, even though we should be in possession of the plants employed by the Chinese, it may be doubted whether we should quite succeed in imitating their ink on the first attempt.

Their pods, which resemble the carob, appear to me to belong to the mimosa. The harshness of their scent is a sufficient indication that they contain much of the astringent principle: how, is it, then, that their decoction does not precipitate gelatine? Have not these vegetable juices need of a new clarifying process?

P. Duhalde speaks of the alkaline properties of the ink; how then shall we reconcile that with the gallic acid contained in juices of the astringent plants? There must, therefore, be some omission, for the alkaline principle could not exist, or at least no one has yet, by any known means, been able to saturate the acid contained in the vegetable decoction; and it may be added, that this Chinese ink may be dissolved in vinegar, without forming any precipitate.

However imperfect this description may be, it nevertheless points out the way to us, by informing us that the Chinese do not use any pure size in the manufacture of their ink, but that they add some vegetable juices, which give the ink greater brilliancy, and fix it more firmly on paper.

In fact, if fine lamp black be intimately combined with pure gelatine, it produces an ink of a fine black tint; but in its fracture it will not be glossy, neither will it be indelible on paper, like the good Chinese ink, with the disadvantage of being affected by the frost in winter.

Here, then, we have obtained two important points :—namely, that it is indispensable, that the ink shall be fluid in winter as well as summer; and also that it shall resist being washed off the paper. The first of these qualities can be easily obtained. For the purpose of making such an alteration in the gelatine as will insure its fluidity to equal that of gum, it only requires that the ebullition should be carried on to an elevated temperature; but as the caloric would, in this action, form an ammoniacal soap, which attracts the moisture of the atmosphere, it would be preferable to employ a process, by which the starch or gelatine may be changed into a gummy and saccharine substance. This method consists in boiling this starchy matter in water, acidulated by sulphuric acid, and afterwards saturating the acid with chalk.

To render the ink insoluble on paper, it is requisite to mix with the animal size some juices of astringent vegetables, so carefully combined as not to occasion any precipitate.

The infusion of nut galls into a solution of gelatine will cause an abundant precipitation, which will unite in a resinous, elastic, and brilliant mass. This compound, which is insoluble in water, can be dissolved in ammonia, (hartshorn,) and in a greater quantity of gelatine. The ammoniacal solution of this precipitate is very brown, but transparent; and when dry it will not dissolve in water.

The resinous matter dissolved in gelatine is still soluble in water after it has been dried, but it dissolves much slower than pure gelatine. It is therefore to the action of the tannin principle on the animal gluten, that we must ascribe the fixedness of Indian ink upon paper.

The size prepared from parchment made of asses' skin is considered the best, though it is not evident at first sight on what account it should have the preference so decidedly; and I must state, that having tried, by way of experiment, to convert asses' skin into size, by passing it through lime, I have only at last succeeded in dissolving it, by steeping it for several days in lime water.

The Chinese attribute to this animal gluten some peculiar medicinal qualities, and it may be that this idea influences them in preparing it with particular care. I have seen some of this size which was very transparent, but I have not been able to procure a portion, to compare it with that made from offal of oxen, &c.

The best size is that sort which, when steeped in water, only swells without dissolving; this species is very rarely found for sale, but in place of it, the Flanders size is the next best.

After having steeped this substance for several hours in water, about three times its weight, which has been acidulated by a tenth part of sulphuric acid, that part of the water is to be drawn off which contains the portion of size which is too soluble, and this must be replaced by an equal quantity of water, slightly acidulated. The size is then to be boiled for an hour or two, and the ebullition brings it to such a condition, that it will not, when cold, return to a state of jelly.

The acid should then be saturated with powdered chalk, with which it is combined by a little at a time, until the resistance of paper shows that the saturation is sufficient. The mixture is then filtered through paper, and it passes quite transparent.

About one quarter of this size is then to be taken away, and upon it should be thrown a solution of the concentrated essence of nut galls; the gelatine then precipitates, and becomes the elastic resin-like substance already mentioned; this matter is then to be washed in warm water, and dissolved in clari-

fied size; it is again filtered, and it is allowed to drew near to the proper state, for the purpose of incorporating it with the lamp black, that too much time may not be lost in waiting until the paste has acquired the proper consistence requisite for its being moulded.

The astringent principle contained in vegetable juices will not form a gelatine precipitate when the acid contained in it has been saturated. Nut galls, or any other vegetable containing much of the astringent principle, may then be boiled with magnesia or lime; and then mixed with the filtered decoction of the size, there will not be any precipitation; and the size thus prepared will be so much less soluble when dry, in proportion to the quantity it may contain of the astringent matter.

It is only by cautiously proceeding that we can ascertain the most just proportion of the astringent matter which ought to be combined with the size.

By whatever mode the excipient is prepared for being mixed with the black pigment, it must be equally well clarified by washing it in plenty of water until it leaves no sediment; whenever this takes place, there is nothing more required than to concentrate its substance to the proper degree of consistency by evaporation.

It is also by proceeding cautiously that we can ascertain the relative proportions of black and size, since that size may be more or less strong; but we shall succeed in this object without difficulty by making the two following trials:—

With a pencil apply a light wash of ink upon a slab of porcelain, and with a pen put some writing on paper; if the ink on the porcelain shines, this is a proof that it has sufficient size in it; and if, after it is dry on the paper, it cannot be washed off by water, it is clear that there is not too much size in the composition.

The Chinese used wooden moulds to form their ink paste, but these moulds may be made very well of potter's clay baked; and when they have not been half vitrified by the fire, they will adhere to the tongue. In this state they absorb a portion of the moisture in the paste, and this facilitates the discharge of the moulded ink in a short time after having been compressed in the mould; the sticks of ink are afterwards covered up in the ashes to prevent their becoming split in the drying; and the moulds may be dried in the sun or on a stove; and if the pores of the latter, after a long service, should cease to absorb the humidity, they should be boiled in a wash of caustic lye, and then dried as usual, or exposed to a red heat.

The quality of the lamp black has a great influence upon the quality of the ink. The black of which the "Imperial Ink" is made, consists of extremely light lamp black, in the preparation of which great care is taken. For this purpose, a metal stove may be employed; into this stove a lamp with many burners must be placed, and surmounted with a large plate of iron; the opening of the stove should be so arranged as to allow the combustion of the lamp to produce as much smoke as possible; and for this purpose various oils and fatty substances are tried to ascertain which will best suit this purpose.

In China, the finest lamp black is prepared from the oil of *girgelin*, which is the oil of sesame.

M. Proust, in the analysis which he made of some Chinese ink of the finest quality, found two per cent. of camphor in it. This substance is also pointed out in a receipt to be found in the Chinese Encyclopedia. From this information, I mixed a little camphor in the ink which I made, and I soon found the good of this addition. When the ink in which it was mixed was in a state of paste strong enough to be moulded, I have pressed it with the fingers slightly touched with oil, and it did not adhere in the slightest degree; in this state it took perfectly the impression of the seal, and this facility of moulding I attribute entirely to the camphor.

REVIEW.

Philosophy in Sport made Science in Earnest. 3 vols. Longman & Co.

A NEW edition of the above work has lately made its appearance, and although we understand that it has continued to sell well ever since its first appearance in 1827, yet not more rapidly nor even so much so as its real and intrinsic merit deserves. The title is a happy one, and shews fully that the intention of the work is to win the student to a consideration of the facts of science, through the medium of his sports. In fact, a father, (Mr. Seymour), takes upon himself to explain to his children the scientific principles involved in their various games and toys, in which he is assisted by a worthy and eccentric vicar, who has a horror of puns, and gives the history and classical allusions of each toy as it offers itself to the family notice. Although written ostensibly for children, there is many a wise and aged head may be informed by a perusal of its pages, and many a person hitherto dreading the tediousness of scientific detail, may be highly amused by the sprightliness of its diction. The following fragment is a fair specimen of the style and character of the work:—

"Mr. Seymour then proceeded. 'This toy is termed the *Thaumatrope.*'

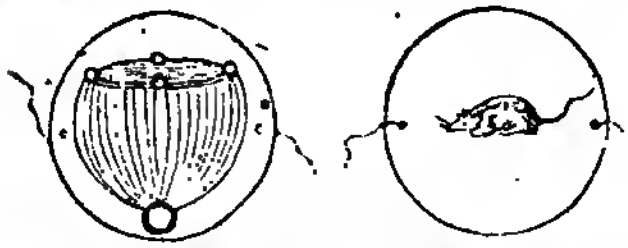
"'Of Grecian origin!'" observed the vicar. "'*Timeo Danaos et dona ferentes,*' as Virgil has it.'

"'What is the meaning of the term?' asked Louisa. The vicar explained to her that it was compounded of the Greek words θαυμα and τρεπω; the former of which signified *wonder*, the latter, *to turn*.

"'Exactly,' replied Mr. Seymour, '*A Wonder-turner*, or, a toy which performs wonders by turning round.; but let me proceed in the explanation.' He then continued to read as follows: 'This philosophical toy is founded upon the well-known optical principle, that an impression made on the retina of the eye, lasts for a short interval, after the object which produced it has been withdrawn. During the rapid whirling of the card, the figures on each of its sides are presented with such quick transition that they both appear at the same instant, and thus occasion a very striking and magical affect. On each of these cards a device is introduced, with an appropriate motto, or epigram; the point of which is answered, or explained, by the change which the figure assumes during the rapid whirling of the card.'

"Mr. Seymour then displayed a pasteboard circle, on the one side of which was figured a rat, and on the other a cage; two strings were fastened in its axis, by which the card could easily be made to revolve by means of the thumb and finger. Fearing that some of our readers may be as dull of comprehension as the vicar, we have introduced a

sketch of the apparatus, in which both sides of the card are exhibited, with the strings by which it is whirled round.



"No sooner had Mr. Seymour put the card in motion than the vicar, in a tone of the greatest surprise, exclaimed, 'Magic! magic! I declare the rat is in the cage!!'

"'And what is the motto?' asked Louisa.

"'Why is this rat like an opposition Member in the House of Commons, who joins the Ministry?' replied Mr. Seymour.

"'Ha, ha, ha,—excellent,' cried the major, as he read the following answer; 'because by *turning round* he gains a snug birth, but ceases to be free.'

"'The very reverse to what occurred in ancient Rome, where the slave became free, by turning round,' observed the vicar.

"The vicar, no doubt, alluded to the custom of making a freeman, as described by Persius', from which it appears that the clapping a cap on the head, and giving him a turn on the heel, were necessary circumstances. A slave, thus qualified, became a citizen of Rome, and was honored with a name more than belonged to any of his forefathers, which Persius has repeated with a great deal of humour in his fifth satire:—

"'——Heu steriles veri, quibus una Quiritem
Vertigo facit!'

"'That false enfranchisement with ease is found
Slaves are made citizens by turning round.'—DRYDEN.

"'Show us another card,' said Tom, eagerly.

"'Here, then, is a watch-box; when I turn it round, you will see the watchman comfortably sleeping at his post.'

"'Very good! It is very surprising,' observed the vicar.

"'Yes,' observed the major; 'and to carry on your political joke, it may be said that, like most worthies who gain a post by *turning round*, he sleeps over his duty.'

"'The epigram which accompanies it is not deficient in point,' said Mr. Seymour.

"'The caprice of this watchman surpasses all bounds:
He ne'er sits in his box, but when going his ROUNDS:
While he no sooner rests, 'tis a strange paradox!
Then he flies from his post, and TURNS out of his box.'

"'What have you there?' exclaimed the vicar; 'arms and legs, without any body?'

"'Yes,' replied Mr. Saymour; 'and which, on turning round, will present the figure of a king, invested with all the insignia of royalty.'

"'It is indeed a king. Look at his crown and sceptre!' cried Louisa.

"'Now for the epigram,' said the major, who then read the following lines:—

"'Heads, legs, and arms, alone appear;
Observe that NOBODY is here;
Napoleon-like I undertake,
Of nobody a king to make.

"The other cards were now exhibited in succession, which the box contained eighteen, and the whole party, not even excepting the vicar, were highly gratified with the amusement.

"'What have we here?' interrupted the major, who had, for the first time, noticed the superscription on the cover of the box; 'had I seen this before, I should have augured favorably of the toy; it is like the sign of an inn, which is held out to announce good entertainment within. He then read the following:—

"The Thaumatrope; being Rounds of Amusement, or how to please and surprise by Turns.

"Mr. Seymour proceeded to explain more fully the optical theory of the instrument, which neither Louisa nor Tom could, as yet, thoroughly understand.

"He told them that an object was seen by the eye, in consequence of its image being delineated on the retina, or optic nerve, which is situated on the back part of the eye; and that it had been ascertained, by experiment, that the impression which the mind thus receives, lasts for about the eighth part of a second, after the image is removed. 'It is, therefore, sufficiently evident,' said Mr. Seymour, 'that if any point, as a lighted stick, be made to revolve, so as to complete the circle in that period, we shall not see a fiery point, but a fiery circle; because the impression made by it in every point of its circuit will remain until it comes round again to the spot from which it set out;—but we will, at once exemplify this fact by an experiment.

"Tom was accordingly directed to procure a piece of stick and a candle, and as soon as they were brought into the room, Mr. Seymour ignited the end of the stick, and whirled it round, when a bright circle, without any intervals of darkness, was seen by the whole party.

"'The pin-wheel is certainly nothing more than a fiery circle, produced by the rapid revolution of a jet of flame,' said the vicar.

"'And the rocket,' added Mr. Seymour, 'is a column of light occasioned by the same rapid movement of a burning body in a rectilinear or curved direction.'

"'I perfectly understand all that you have said,' observed Tom.

"'Then you will not have any difficulty in explaining the action of the Thaumatrope, for it depends upon the same optical principle; the impression made on the retina by the image, which is delineated on one side of the card, is not erased before that which is painted on the opposite side is presented to the eye; and the consequence is, that you see both sides at once.'"

A Pint of Water converted into Two Hundred and Sixteen Gallons of Steam will raise thirty-seven tons a foot high; and if the steam is allowed to expand to double that volume, twice that weight. The greatest load ever lifted by any steam engine in England, was by one in the Consolidated Mines in Cornwall, on the expansion principle, which raised a load of 90,000 lbs., seven feet six inches high, every double stroke it made, and this nine times a minute.

QUERIES.

139—What is the composition of Vancouver's cement?—*Answered on page* 271

140—Is there any method of condensing smoke?—Yes, smoke is always condensed by cold, when it forms soot, or by any impediment which it strikes against: thus lamp-black is made by the smoke of lamps being intercepted, either by an iron plate put over it, or suffering it to pass into chambers, lined with sack-cloth.

OIL PAINTING.

Oil Painting exceeds all other methods in its accuracy of colors and in its wonderful force and expression. It surpasses miniature and other painting in its extended dimensions, whereby most objects of animated nature may be presented as large as life, by which means the imitation is rendered so complete, and the powers of illusion so perfected, as to astonish those who are inexperienced in the art. The principal advantage of oil painting consists in the colors drying less speedily than in other modes, so that it allows the painter to finish, smooth, and retouch his works with greater ease

and precision. The colors also being more blended together produce more agreeable gradations, and a more delicate effect.

The ancients are said to have been ignorant of the secret of painting in oil, which is only the grinding the usual colors in this medium. It was likewise unknown to the first masters of the modern Italian schools, and is generally thought to have been discovered in the 14th century; it was first used on board or panel, afterwards on plates of copper, and on linen cloth.

As the superior beauty of oil painting depends on the vividness and delicacy of durable tints, we shall present the student with the best rules, drawn from a careful study of the works of Vandyke and Rembrandt, two of the most remarkable colorists in different styles; first treating of the necessary materials; portrait painting; next of draperies; then of the back-ground; and lastly of landscapes.

NECESSARY MATERIALS.

The materials to be provided are a palette, (see engraving, fig. 5.) A palette-knife, fig. 8. Pencils, tools, or brushes. An easel, fig. 1. Picture-cloths, fig. 2. A maul-stick, fig. 3. Tin cups to hold oils, &c., fig. 4, and oil colors, oils and turpentine, a box adapted to the holding of which is seen in fig. 6. A separate bladder of color in fig. 7.

The *Palette* is used to contain the color, being held on the left hand while at work, by passing the thumb through a hole near the front; to set the palette is to place the colors thereon in their proper order. The lighter colors are placed next the hand, the darker ones next, increasing in depth according to their distances from the front, a second row of tints is then formed of the original colors, by mixing these together in such proportions as to produce tints to suit the subject of the piece; a third row of tints must also be made, which should, if possible, approach nearer the complexion of the piece than the second row.

The *Oil Colors* are best kept in bladders, (which may be purchased at any artists' colorman,) and when wanted for use the bladder is to be pricked with a small tin tack, and no more color squeezed out than is necessary for present use, otherwise it will spoil.

The *Palette-Knife* is a thin well-tempered blade, its use is to mix and work up the colors on the palette.

Pencils are generally of two sorts, viz., camel's hair pencils and fitch pencils.

Fitch pencils are used by some artists to give a smoothness to their pictures, by working the colors into each other after they have been laid on with the camel's hair pencil, this is called *scumbling* the colors; others who wish to give a bold appearance to their works paint wholly with fitches.

Tools are only a larger kind of pencils, not inserted into quills, like the foregoing, but the hairs are bound round a stick, in the same manner as the pencils used by house-painters. They are of a stronger nature. Some good artists have used no others. There is also another sort of pencils having very long hairs, used chiefly by painters of shipping, to describe the ropes, &c.

The *Easel* is formed various ways according to the fancy of the artist; its use is to support the picture or canvas upon which the painter is employed. The most common form for it is three straight legs, the longest being behind. In the two front legs are a number of holes, corresponding in height to each other, in order that when a peg is placed in the corresponding holes of each leg they support evenly whatever is laid upon them. A slight piece of board is usually placed on these pegs to support small pictures.

Picture-Cloths are those substances upon which the picture is painted. They were formerly almost universally of canvas, but artists now generally prefer a sort of ticking made for the purpose. Landscape painters generally choose cloth of a very smooth surface.

The cloth or canvas upon which the picture is to be painted is generally first primed. The priming is no more than laying on a smooth coat of color, or it is covered with a layer of size, or other glutinous substance, to prevent the oil from penetrating and being wholly absorbed during the painting of the picture, these preparations are well known by all colormen. It is not of any great consequence what particular tint it is formed of, provided it is rather light than dark; portrait painters choose a very thin priming, and many modern artists, whose works have met with general approbation, do not prime their cloths at all.

A *Maul Stick* is a thin rod of wood, with a ball of cotton or some other soft substance, tied to one end so that it may rest against the picture without damaging it. Its use is to support the right hand while at work, being held in the left hand, with the cotton ball resting against the painting. This implement is not in universal use, many artists wholly reject it as being pernicious to that freedom of hand necessary to a good painter.

In our next paper we shall give a list of the colours, with the principal tints used in poritrait painting.

(Continued on page 293.)

BRITISH MARBLES.

Great Britain is by no means poor in fine varieties of marble, and there can be no doubt that the number of British marbles we are at present acquainted with will be considerably augmented when accurate research shall have been extended to those parts of the United Kingdom that are most likely to furnish this interesting subject of economical mineralogy.

Black marble is found in Derbyshire at Ashford, Matlock, and Mousaldale. Black and white marble in the north part of Devonshire; the varieties from Bridestow, South Tawton, and Drewstrignton are some black, others inclining to bluish black. Some of the Chudley marble, and those of Staverton and Berry Pomeroy have a black ground, with large veins of calcareous spar traversing it in all directions; also red, straw colored, and greenish veins are seen in it. Black, with white veins occurs at Buckfastleigh; and black with yellow and white veins at Bickington near Ashburton in the same county. Intense black marble with distant white spots is found also in Somersetshire.

The variegated marbles of Devonshire are generally reddish, brownish, and greyish, variously veined with white and yellow, and the colors are often intimately blended. At Waddon there is a quarry of dunnish colored marble, veined with green; there is another at Cherston.

The Plymouth marble is principally of two sorts; one ash color, shaded with black veins; the other blackish grey and white, shaded in concentric stripes, interspersed with irregular spots. The cliffs near

Marychurch exhibit marble, not only of great extent, but of superior beauty to any other in Devonshire; being for the most part either of a dove colored ground, with reddish purple and yellow veins, or of a black ground mottled with purple globules. In a valley below the cliff, about 400 yards wide, there are loose unconnected rocks of this marble, owing their situation probably to the falling down of the ground into the sea, for there are very large rocks even on the beach. The huge fragments of rocks scattered over the valley, by which we easily descend to the sea, give it a grotesque appearance, and have been whimsically called a petrified congregation; and the pleasantry of this fancy has been heightened by a rock supposed to be about 40 tons, in a very erect position, which has been ludicrously enough entitled "the parson."—*Polwhele's Devon.*

There are several fine varieties of marble in Derbyshire, particularly such as are composed of petrifactions. The largest quantity of the mottled grey marble is got in the neighbourhood of moneyash, it may be distinguished into two kinds; the ground of the one is light grey, and that of the other has a slight bluish cast. The former is rendered extremely beautiful by the number of purple veins which spread upon its polished surface in elegant and irregular branches. But the chief ornament of the mottled grey marble is the number of entrochi with which it abounds. The longitudinal and transverse sections of them produce an almost incredible variety in its figure. The purple veined marble is got at Ricklowdale, near Moneyash, that with the blueish ground at the village itself, there is another variety at a small distance from hence at a place called Highlow, it is known by the name of Birdeye marble (Pilkington.) The marble of Purbeck in Dorsetshire is composed of fragments of shells united by a compact limestone, partly of a yellow color, and mingled with a greenish martial earth and black and yellowish particles of bitumen.

A shell marble which is far from being beautiful, but which in former times has being much employed for architectural purposes, is the Petworth marble, from a place of that name in Sussex. It is thus described by Woodward, "the ground grey, with a cast of green, 'tis very thick, set in all parts of it with shells, chiefly turbinated; some of them seem to be of that sort of river shell that Dr. Lister (Hist. Cochl. Angl. p. 133) calls cochlea maxima fusca inigricans fasciata. Several of the shells are filled with a white spar, which variegates and adds to the beauty of the stone. That spar was cast in the shell before this was reposited in the mass of marble as is demonstrable from a view of this and other like masses; this is of about the hardness of the white Genoese marble. The slender round scapi of the pillars of the abbey church in Westminster, and of the Temple church are of this marble; so likewise are those of the cathedral church of Salisbury. Some persons that are less skilful in these matters fancy these scapi that occur in most of the larger gothic buildings of England are artificial, and will have it that they are a kind of fusil marble cast in cylindric moulds. Any one who shall compare the grain of the marble of those pillars, the spars, and the shells in it with those of this marble, got in Sussex, will soon discover how little ground there is for this opinion, and yet it has prevailed very generally; Camden entertained the same notion of those vast stones of Stonehenge; but it is fully refuted by Inigo Jones, in (Stonehenge Restored, p. 33.)

(Continued on page 291.)

DIFFERENT KINDS OF OILS AND FATS.

It is established that the oils and fats are capable, when in a fluid state, of combining with gases and salts, as well as with organic substances of different kinds. Now, when the oily matter is expressed from the seeds of vegetable or from the organs of animals, it is impossible but that the salts and other matters which may exist in the seed or organ must be expressed also, and brought artificially into contact with it, by which means a mixture of them with it will be produced. There is also strong reason to believe that similar admixtures take place naturally in the organs of the plant under the influence of the laws of vegetation.

But, if we admit these considerations, must we not also admit a consequence which flows from them, viz. that the specific differences of the oils are to be attributed to the nature of the extraneous substances that are dissolved in them? Without this hypothesis the characteristic differences of the oils are inexplicable. How otherwise could it be conceived that substances whose elementary analysis presents so little difference, and which may all be considered as combinations of a greater or less quantity of bicarburetted hydrogen with water, should produce such different effects on the animal economy, some being alimentary, while others act as poisons, or as more or less violent drastics.

Some authors have suspected the existence of similar mixtures in the oils that are found in commerce. Thus Soubeyran tried to prove that the purgative qualities of castor oil are owing to an acrid resin, which he extracted by saponifying the oil by potash, precipitating with quick-lime or chloride of calcium, and treating the precipitate by boiling alcohol, which deposits the soap on cooling. The alcoholic solution is then evaporated, and ether is added to the residue by which the resin is dissolved while any remaining portion of the soap is left unacted on. But it was objected to him that he had not experimentally proved the laxative power of the substance thus extracted. The properties of castor oil had also, in France, been attributed to an acrid substance contained in the seeds; but Guibourt opposed this opinion, and asserted that this substance is so volatile that it is dissipated by the heat which is necessary for the extraction of the oil, either by expression or by boiling in water. This objection will be seen to be of very little force, if we recollect that, when acetic acid is united to albumen combined with a very small portion of phosphate of lime, it loses its volatility. It is possible, then, that a portion of this acrid substance may remain fixed in consequence of its more intimate combination with the oil.

Analogy would lead us to believe that all the oils are identical; that their difference in color, smell, medical properties, &c., depend on the extraneous substances that are combined with them; and that their really distinctive characters, inherent to their elementary composition, consist in their greater or less fluidity and solubility in alcohol, arising from the greater or less proportion of oxygen which they contain.

Chemists ought to endeavour not only to ascertain the other differences that may exist among them, but also to discover their causes, and the means of producing artificially the effects which result from them. The principal result of this philosophical inquiry would be, to expunge from the catalogues of science that long list of species and varieties to which, as yet, every petty attempt at research is daily adding some new name.

Extraction.—The vegetable oils are extracted by expression, in general at the ordinary temperature, but some that are less fluid require the application of heat.

As the best quality of olive oil is found in the *drupa* of the fruit, it follows that the *Virgin Oil* is obtained by the first pressing, while the second pressing by which the stones are broken, gives an oil of inferior quality, and that which is obtained by boiling the residue in water and skimming off the oil that gathers on the surface is the worst of all. It must be evident that, between these three, there may exist an affinity of gradations, though incapable of being distinguished in commerce; but these differences, being mechanically produced, give strength to what has been said on the distinctive qualities of the different oils. The oil of the olive cannot be extracted but from fruit that is fully ripe, which is known by the pericarp acquiring a black color and becoming soft and wrinkled. By leaving them for a time to ferment spontaneously, the quantity of oil is increased although the quality is impaired.

Purification.—Various processes are had recourse to, with the view either of preventing or removing the sediment which is apt to be formed in the different oils that are used in domestic economy or in the arts.

Those oils that are to be used for giving light are purified by agitating them with one or two per cent. of sulphuric acid, which throws down from them a green coloring matter.

Olive oil which is to be used in the oiling the delicate machinery of time-pieces is purified by putting it into a close-stopped bottle along with a plate of lead, and exposing it to the sun. By degrees the lead becomes covered with a cheesy-looking mass, which afterwards falls to the bottom and leaves the oil limpid. Perhaps the action which takes place here may be analogous to that which produces the *Arbor Dianæ*. Watchmakers have other processes, which are kept secret, for diminishing the thickness of this oil, and some of them have made a fortune by selling to their brethren purified oil under the name of "Old oil." Perhaps they employ lime and distillation by a gentle heat.

Note.—Elaine, prepared by freezing olive oil, separating the stearine by means of blotting paper, and then expressing the elaine under water, has been used with advantage; but great care is required in freeing it from the water which it is necessarily impregnated with. Simply freezing the oil and pouring off the unfrozen portion, though it does not produce an oil so free from congealed particles, is a less objectionable process and was for many years used by Bartovil in London with great success.

Adulteration of Oils.—Olive oil as designed for the table is often adulterated with the oil of the poppy, and that which is used in the arts by the addition of rape oil. Rousseau has proposed a method of detecting these adulterations, founded on this, that the conducting power of olive oil for electricity is 655 times less then that of any other vegetable oil. He employs for this purpose a galvanic pile, one of whose poles communicate with the earth while a wire connected with the other is brought near a feebly-magnetised and freely-suspended needle. The purity or impurity of the oil is known by the degree in which the declination of the needle is diminished, on applying a drop of it to this wire. Two drops of oil of poppies are sufficient to quadruple the conducting power of three drams of olive oil. It is known that the conducting power of water depends on the salts which it holds in solution; may not the same thing be the case with the oils? May they not owe their conducting power to the quantity of the kind of salts which they contain?

Illumination.—Those oils which are liquid at the ordinary temperature or employed for feeding lamps; and the fat of mutton, beef, &c., is moulded in cylinders into which a cotton wick has been put, in order to be made into candles. Too much has been expected from the applications that might be made of the recent researches on the fatty bodies to manufactures, and inventors have been in haste to take out patents and form joint-stock companies. The results have disappointed their expectations; the altered products of the laboratory gave good promise, but did not burn well; and it is certain that experience has done more than science to improve the art of obtaining light from these bodies. By the help of certain mixtures, either of alum, arsenic, or of spermaceti, candles have been made, which burn as well as those made of suet, and are harder.

The oil of the *Crassica Bampestris* and of the *B. Napus*, or rape oil, is that which, even without being purified, gives least smoke in burning, and that of the *Juglans Regia* is the one which gives most smoke.

CASE-HARDENING.

Case-hardening is the name of the process by which iron tools, keys, &c., have their surfaces converted into steel.

Steel when very hard is brittle, and iron alone is for many purposes, as for fine keys, far too soft. It is therefore an important desideratum to combine the hardness of a steely surface with the toughness of an iron body. These requisites are united by the process of case-hardening, which does not differ from the making of steel, except in the shorter duration of the process. Tools, utensils, or ornaments, intended to be polished, are first manufactured in iron and nearly finished, after which they are put into an iron box, together with vegetable or animal charcoal in powder, and cemented for a certain time. This treatment converts the external part into a coating of steel, which is usually very thin, because the time allowed for the cementation is much shorter than when the whole substance is intended to be converted. Immersion of the heated pieces into water hardens the surface, which is afterwards polished by the usual methods. Moxon in his *Mechanical Exercises*, p. 56., gives the following receipt for case-hardening:—"Cow's horn or hoof is to be baked thoroughly dried and pulverised. To this add an equal quantity of bay salt; mix them with stale chamber-lye or white wine vinegar; cover the iron with this mixture, and bed it with the same in loam, or inclose it in

an iron box; lay it on the hearth of the forge to dry and harden; then put it into the fire, and blow till the lump have a blood-red heat, and no higher, lest the mixture be burnt too much. Take the iron out, and immerse it in water to harden."

The recent application of prussiate (ferrocyanate) of potash to this purpose is as follows:—The piece of iron, after being polished, is to be made brightly red-hot, and then rubbed or sprinkled over with the above salt in fine powder, upon the part intended to be hardened. The prussiate being decomposed, and apparently dissipated, the iron is to be quenched in cold water. If the process has been well managed, the surface of the metal will have become so hard as to resist the file. Others propose to smear over the surface of the iron with loam made into a thin paste with a strong solution of the prussiate, to dry it slowly, then expose the whole to a nearly white heat, and finally, to plunge the iron into cold water, when the heat has fallen to a dull redness.

GLASS BLOWING.

(Resumed from page 243.)

When you desire to form a bulb at the extremity of a capillary tube, that is to say, of a tube which has a bore of very small diameter, such as the tubes which are commonly employed to form thermometers, it would be improper to blow it with the mouth; were you to do so, the vapour which would be introduced, having a great affinity for the glass, would soon obstruct the little canal, and present to the passage of the air a resistance, which, with the tubes of smallest interior diameter, would often be insurmountable. But, even when the tubes you employ have not so very small an internal diameter, you should still take care to avoid blowing with the mouth; because the introduction of moisture always injures fine instruments, and it is impossible to dry the interior of a capillary tube when once it has become wet. It is better to make use of a bottle of Indian rubber, which can be fixed on the open end of the tube by means of a cork with a hole bored through it. You press the bottle in the hand, taking care to hold the tube vertically, with the hot part *upwards*: if you were not to take this precaution, the bulb would be turned on one side, or would exhibit the form of a pear, because it is impossible, in this case, to give to the mass in fusion that rotatory motion which is necessary, when the tube is held horizontally, to the production of a globe perfectly spherical in its form, and with sides of equal thickness.

Whenever you blow into a tube you should keep the eye fixed on the dilating bulb, in order to be able to arrest the passage of air at the proper moment. If you were not to attend to this, you would run the risk of giving to the bulb too great an extension, by which the sides would be rendered so thin that it would be liable to be broken by the touch of the lightest bodies. This is the reason that, when you desire to obtain a large bulb, it is necessary to thicken the extremity of the tube, that it may possess more solidity.

In general, when you blow a bulb with the mouth, it is better to introduce the air a little at a time, forcing in the small portions very rapidly one after the other; rather than to attempt to produce the whole expansion of the bulb at once; you are then more certain of being able to arrest the blowing at the proper time.

When you desire to produce a moderate expansion, either at the extremity or in any other part of a tube, you are enabled easily to effect it by the following process, which is founded on the property possessed by all bodies, and especially by fluids, of expanding when heated; a property which characterises air in a very high degree. After having sealed one end of the tube, and drawn out the other, allow it to become cold, in order that it may be quite filled with air; close the end which has been drawn out, and prevent the air within the tube from communicating with that at its exterior; then gradually heat the part which you desire to have expanded, by turning it gently in the flame of a lamp. In a short time the softened matter is acted on by the tension of the air which is inclosed and heated in the interior of the tube; the glass expands, and produces a bulb, or swelling, more or less extensive, according as you expose the glass to a greater or lesser degree of heat.

To blow a bulb in the middle of a tube, it is sufficient to seal it at one of its extremities, to heat the part that you wish to inflate, and when it is at a *cherry-red* heat, to blow in the tube, which must be held horizontally and turned with both hands, of which for the sake of greater facility, the left may be held above and the right below.

If the bulb is to be large, the matter must previously be thickened or accumulated: or, instead of that, a series of small bulbs first produced, and these subsequently blown into a single larger bulb, as we have already mentioned.

For some instruments, the tubes of which must be capillary, it is necessary to blow the bulbs separately, and then to solder them to the requisite adjuncts. The reason of this is, that it would be too difficult to produce, from a very fine tube, a bulb of sufficient size and solidity to answer the intended purpose.

To obtain a *round* bulb, you should hold the tube horizontally; to obtain a *flattened* bulb, you should hold it perpendicularly, with the fused extremity turned above; to obtain a *pear-shaped* bulb, you should hold the fused extremity downwards.

When you are working upon a bulb between two points, or in the middle of a tube you should hold the tube horizontally in the ordinary manner; but you are to push the softened portion together, or to draw it out, according as you desire to produce a ridge or a prolongation.

When you are at liberty to choose the point from which you are to blow, you should prefer 1st, that where the moisture of the breath can be the least prejudicial to the instrument which is to be made; 2dly, that which brings the part which is to be expanded nearest to your eye; 3dly, that, which presents the fewest difficulties in the execution. When bulbs are to be formed in complicated apparatus, it is good to reflect a little on the best means of effecting the object.

Piercing.—You first seal the tube at one extremity, and then direct the point of the flame on the part which you desire to pierce. When the tube has acquired a *reddish-white* heat, you suddenly remove it from the flame, and forcibly blow into it. The softened portion of the tube gives way before the pressure of the air, and bursts into a hole. You expose the tube again to the flame, and border the edges of the whole.

It is almost superfluous to observe, that, if it be a sealed extremity which you desire to pierce, it is necessary to turn the tube between the fingers

while in the fire; but if, on the contrary, you desire to pierce a hole in the side of a tube, you should keep the glass in a fixed position, and direct the jet upon a single point.

If the side of the tube is thin, you may dispense with blowing. The tube is sealed and allowed to cool; then, accurately closing the open extremity with the finger, or a little wax, you expose to the jet the part which you desire to have pierced When the glass is sufficiently softened, the air inclosed in the tube being expanded by the heat, and not finding at the softened part a sufficient resistence, bursts through the tube, and thus pierces a hole.

You may generally dispense with the sealing of the tube, by closing the ends with wax, or with the fingers.

There is still another method of performing this operation, which is very expeditions, and constantly succeeds with objects which have thin sides. You raise to a *reddish white* heat a little cylinder of glass, of the diameter of the whole that you desi to make, and you instantly apply it to the tube or globe, to which it will strongly adhere. You allow the whole to cool, and then give the auxiliary cylinder a sharp slight knock; the little cylinder drops off, and carries with it the portion of the tube to which it had adhered. On presenting the whole to a slight degree of heat, you remove the sharpness of its edges.

When you purpose to pierce a tube laterally, for the purpose of joining to it another tube, it is always best to pierce it by blowing many times, and only a little at a time, and with that view, to soften the glass but moderately. By this means the tube preserves more thickness, and is in a better state to support the subsequent operation of soldering. There are circumstances in which you can pierce tubes by forcibly sucking the air out of them; and this method sometimes presents advantages that can be turned to good account.

(Continued on page 283.)

REMARKS ON GLACIERS.

BY M. AGASSIZ.

A GLACIER is a mass of ice hanging on the sides of an Alpine ridge, or inclosed in one of its valleys, and which is moving *continually* down the declivity. I say continually, for the glacier is always descending; if the extremity should at any time seem to retire, this implies nothing more than that the portion of the ice, melted by the heat of summer, is more considerable than that which the glacier brings along with it in its progress.

This movement of the ice, which many refused for a long while to admit, is now known and acknowledged by every observer; but there is a great contrariety of opinion respecting the cause which produces it. The opinion generally received from the time of Saussure, is, that the descent of a glacier is nothing more then a slipping upon itself, occasioned by its own weight. But there are many reasons for doubting the accuracy of this explanation. The motion appears to be much more properly ascribed to the expansion of the ice resulting from tha congelation of the water which has filtered into it and penetrated its cavities. The ice of glaciers, it must be observed, has not the continuous texture of ordinary ice; it is composed of a multitude of fragments, which have been improperly called crystals by Hugi. We may easily convince ourselves of this by breaking a portion, or infusing a colored liquid, which penetrates into the fissures separating the fragments, and allows us to distinguish their form and size. It is easy to perceive that their size diminishes in proportion as we ascend either from the bottom of the glacier towards the surface, or from its lower to its upper part or origin. Here they may be seen reduced to mere granules, so that the ice, losing more and more its transparency and compactness, insensibly passes (nearly at a uniform elevation among the Alps) into the state of a coarse snow which is known to the mountaineers by the term *firn* or *haut neve*. A glacier is, therefore, a spongy mass, continually imbibing atmospheric waters, as well as those produced by the melting of its surface, and which infiltrate into the capillary fissures which the ice presents throughout its whole thickness, and particularly at the portion nearest the surface where it is less compact. The temperature of this water being always near the freezing point, it is converted into ice by the least sinking of the temperature, and tends to dilate the glacier in every direction. But as it is restrained on two sides by the flanks of the valley, and above by the weight of the superior masses, the whole act of dilatation, aided besides by that of gravitation, tends to urge it down the declivity to the only side which offers a free passage. This explanation being once admitted, it follows that the more frequently the alternations of freezing and melting take place, or the variations of the temperature are above and near zero, the more rapid will be the advance of the glacier subjected to them. Thus it happens that winter, when the entire mass is frozen in an equal manner, is the season when it is in a state of rest.

The progress of the glacier is not uniform throughout the whole thickness of the mass; but if we suppose it divided into beds parallel to its surface, each of these beds or layers will advance with greater rapidity in proportion as it is nearer the surface, or in other words, as it is more exposed to the influence of atmospheric changes. It will be perceived that this difference in quickness will become more obvious in the upper beds, because there must be added to the quickness, proper to each of them, that of all the beds inferior to it; so that if the bed at the bottom move with the quickness of 1, the second with the quickness of 2, the third of 3, and so on, the quickness of the third, for example, will be 3 added to 2, and 1 or 6.

A glacier, when seen in a vertical section, often exhibits a series of beds of variable thickness, sufficiently distinct in the upper part, less evident in the middle, and more or less obliterated below, according as the mass, from being exposed to moisture, has been more or less completely converted into transparent ice. These beds diminish in thickness from the top downwards, no doubt by an effect of the *tassement*, and represent the additional beds which the glacier receives every year. (Upper glacier of the Grindelwald, Trient, &c.)

(Concluded on page 275.)

SOLDERS.

SOLDERING is the process of uniting the surfaces of metals, by the intervention of a more fusible metal, which being melted upon each surface, serves partly by chemical attraction, and partly by cohesive

force, to bind them together. The metals thus united may be either the same or dissimilar; but the uniting metal must always have an affinity for both. Solders must, be therefore, selected in reference to their appropriate metals. Thus tin-plates are soldered with an alloy consisting of from 1 to 2 parts of tin, with 1 of lead; pewter is soldered with a more fusible alloy, containing a certain proportion of bismuth added to the lead and tin; iron, copper, and brass are soldered with spelter, an alloy of zinc and copper, in nearly equal parts; silver, sometimes with pure tin, but generally with silver-solder, an alloy consisting of 5 parts of silver, 6 of brass, and 2 of zinc; zinc and lead, with an alloy of from 1 to 2 parts of lead with 1 of tin; platinum, with fine gold; gold, with an alloy of silver and gold, or of copper and gold; &c.

In all soldering processes, the following conditions must be observed:—1. the surfaces to be united must be entirely free from oxide, bright, smooth, and level; 2. the contact of air must be excluded during the soldering, because it is apt to oxidate one or other of the surfaces, and thus to prevent the formation of an alloy at the points of union. This exclusion of air is effected in various ways. The locksmith encases in loam the objects of iron, or brass, that he wishes to subject to a soldering heat; the silversmith and brazier mix their respective solders with moistened borax powder; the coppersmith and tinman apply sal ammoniac, rosin, or both, to the cleaned metallic surfaces, before using the soldering-iron to fuse them together with the tin alloy. The strong solder of the coppersmith consists of 8 parts of brass and 1 of zinc; the latter being added to the former, previously brought into a state of fusion. The crucible must be immediately covered up for two minutes till the combination be completed. The melted alloy is to be then poured out upon a bundle of twigs held over a tub of water, into which it falls in granulations. An alloy of 3 parts of copper and 1 of zinc forms a still stronger solder for the coppersmith. When several parts are to be soldered successively upon the same piece, the more fusible alloys, containing more zinc, should be used first. A softer solder for coppersmiths is made with 6 parts of brass, 1 of tin, and 1 of zinc; the tin being first added to the melted brass, then the zinc; and the whole well incorporated by stirring.

ANSWERS TO QUERIES.

8 and 35—*How are Childe's "Dissolving Views" managed?* By two magic lanthorns fixed at the same focus. A view being placed in each, and the lamps lighted, the light of one lamp is diminished almost to extinction; the other lamp burning with intensity; the scene before it is clearly seen. To constitute the second view; diminish the light of the first and proportionably increase that of the second, when of course a change of scene will be the consequence. Substituting other sliders for the first, a constant variation is accomplished. Moveable sliders are sometimes employed. The snow seen in one view is we believe a moveable slider used by the second lanthorn at the same time as the winter scene is shown by the first.

43—*Paintings in imitation of mezzotinto are sometimes executed in lamp black and soap; what is the process?* Rub a mixture of lamp-black and soap upon the surface of white canvas, pasteboard, or paper, until the whole appears quite black—then take out the lights with a needle, a hard stump, or by scraping them away with the blade of a penknife; by these simple means we have seen pictures delicate enough for a lady's album. Full size figures from the ancient masters, particularly Murillo, we have also seen admirably imitated by this style.

56—*How is glass stained?* Answered in page 251.

115—*How are colored flames for fire-works produced?* Answered in page 256.

123—*How is marble best cleaned and whitened?* Answered in page 232.

126—*Would an electrical machine made with a resinous plate, instead of one of glass, be effective?* No; because the negative spark is much shorter and less brilliant then the positive—it is also much less easily excited. There is nothing equal to glass.

129—*How is horn to be dissolved, or reduced to a gelatinous substance?* Horn, as well as bone, ivory, and tortoiseshell may be wholly dissolved in water, if the latter be raised to a degree of heat somewhat more then boiling water; as for example in the Papin's digester: a less degree of heat will render it gelatinous. If cut into very fine shavings, boiling water is sufficient.

131—*What is the composition of Sympathetic Inks?* Answered in page 214.

137—*How is Oil best prepared for Watch Makers, &c.* Answered in page 268.

138—*How is the raising Composition for Chinese Japanning Work made?* Gold size, mixed with whiting, to which is added a little red lead, to harden it, and a little powdered litharge to dry it more rapidly.

139—*How may Prints be transferred to Wood?* First varnish the wood once with white hard varnish, which facilitates the transferring; then cut off the margins of the print, which should be on unsized paper; that is, paper that absorbs like blotting paper; and wet the back of it with a sponge and water, using enough water to saturate the paper, but not so as to be watery on the printed side. Then, with a flat camel-hair brush, give it a coat of transfer (spirits of wine) varnish on the printed side, and apply it immediately—varnished side downwards—on the wood-work, placing a sheet of paper on it and pressing it down with the hand, till every part adhere. Then, gently rub away the back of the print with the fingers, till nothing but a thin pulp remains. It may require being wetted again, before all that will come (or rather ought to come) off is removed. Great care is required in this operation, that the design or printed side be not disturbed. When this is done, and quite dry, give the work a coat of white hard varnish, and it will appear as if printed on the wood. H.P.

139—*What is the composition of Vancouver's Cement?* We believe that this is composed merely of the white of egg dried, finely pulverized, and mixed with a small quantity of lime.

To the Editor.

Sir—A curious freak of nature occurred to a hen in my possession, which was killed a few days since; it was a chicken about four years ago, and quite black since then, every time it has moulted, instead of black feathers re-appearing white have now appeared instead. At first it was slightly speckled, then more white, and this year it was a

speckled, then more white, and this year it was a perfect white. This is a fact, though a hard thing for many to believe. J. WEST.

Commercial Road, Stepney.

MISCELLANIES.

The Harmoniphon.—A musical instrument, lately invented by M. Paris, of Dijon, has attracted much notice in France. It resembles the instrument called the Concertina, well known in London from the very clever performance of young Regondi; but it seems to be superior, in some respects, to the Concertina. The sound is by the vibration of thin metallic plates, and it is played by keys like those of the piano-forte; but the air which acts upon the vibrating substances, instead of proceeding from bellows within the instrument, is blown by the mouth through an elastic tube. The excellence of the instrument, accordingly, consists in this, that while the figures on the keys merely mark the different notes of the scale, the expression lies in the mouth. It is the living breath of the performer which gives accent, articulation, and emphasis to the notes, as in the oboe, or clarionet, and enables the performer to "discourse most eloquent music" in a manner which the production of sound by the mechanical contrivance of a bellows does not admit of. The Harmoniphon is made in three varieties; the first is of the compass of the oboe, the second of the Corno Inglese, and the third, (of a larger size than the others,) combines both these instruments, and has a compass of three octaves. This instrument is highly approved by the French composers; and one of them, M. Adam, has given an account of it in the "Monde Dramatique," in which its capabilities are pointed out. It is calculated, in particular, to be of great utility in provincial orchestras, where it is an excellent substitute for the oboe—an instrument as disagreeable in the hands of an ordinary performer as it is delightful in those of a Grattan Cooke. Accordingly we are informed, the Harmoniphon has already been adopted in the orchestras of many provincial theatres and musical societies.

Improvement in the Daguerréotype.—Amongst the numerous improvements proposed in the Daguerréotype is the following, by M. Jobard, of Brussels, for taking portraits *á Héliographe*:—"Paint in dead white the face of the patient; powder his hair, and fix the back of his head between two or three planks solidly attached to the back of an arm-chair, and wound up with screws! The color of the flesh not reflecting sufficiently the rays of light, would require a powerful sun, whereas a whitened face will be produced as well as plaster figures by diffused light."

Killing Insects for the Cabinet.—Procure a tin box about three inches in diameter and four or five in length; put the insect, pinned to a piece of cork, into it; close the lid as air-tight as possible, and place it in boiling water for a few minutes. It never fails to kill any insect, let it be ever so tenacious of life, neither does it injure their color.

Modelling Wax.—The following will be found a most excellent compound for forming ornaments from which moulds may be made; and, consequently, ornaments cast again for picture frames, &c.:—½ lb. of diaculum; ½lb. of bees' wax; ½lb. of Burgundy pitch. Melt these together, and mix sufficient chalk to form the composition into a paste; make them into small sticks, and they will be ready for use at any time.

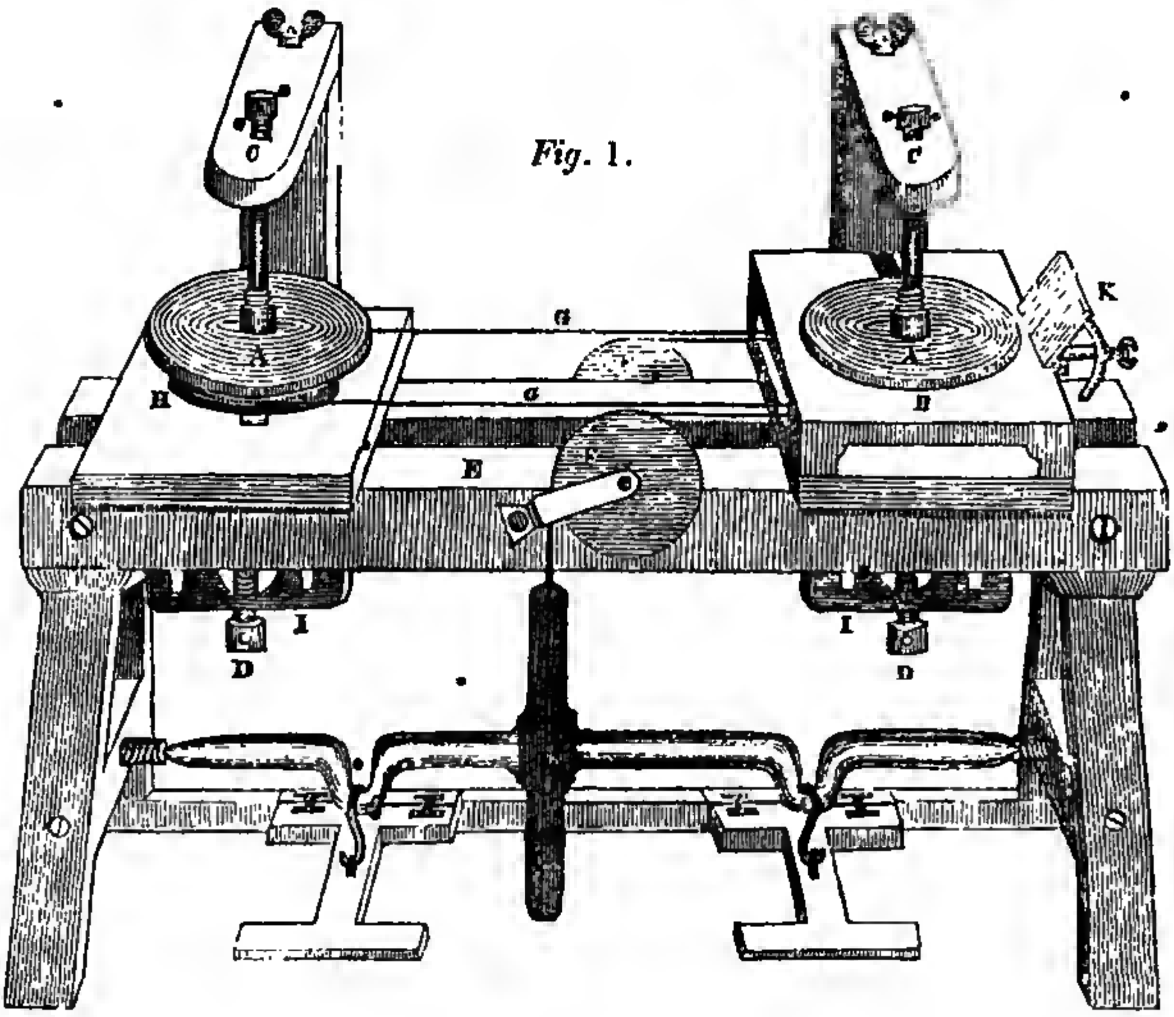
Nature of Mineral Precipitates.—At the meeting of the Society of Friends of Natural History, held at Berlin, Mr. Link communicated some observations on the formation of crystals. If fresh precipitates of many of the minerals are examined, they are found to be entirely composed of little globular bodies, which change, under the eye of the observer, into the crystals peculiar to the metal. This, however, is not effected by their juxta-position, but by their bursting into each other, and uniting like soap-bubbles.—That these globules are hollow is not only proved by their difference in size in the same precipitate, but also by the angular and irregular forms which they present when dried up.

Separation of Lime and Magnesia.—If anhydrous chloride of magnesium be heated in the air, it absorbs oxygen and gives off chlorine. This decomposition, that is to say, the conversion of chloride of magnesium into magnesia, is more quick and complete when chlorate of potash is used instead of air as an oxidizing agent. This property renders the separation of lime and magnesia very easy. A mixture or compound of these two bodies, dolomite for example, is to be dissolved in hydrochloric acid; the solution is to be evaporated to dryness; the residue of the evaporation is to be heated in a platina capsule, till it ceases to yield hydrochloric acid, and then there are to be gradually added to the mass heated to low redness, small portions of chlorate of potash, till the disengagement of chlorine ceases. The residual mass is then a mixture of magnesia, chloride of calcium, and chloride of potassium, which are readily separated by treating the mixture with water, which dissolves the chloride of potassium and of calcium, while the magnesia is left; from the mixture of chloride of potassium and of calcium the lime is precipitated by carbonate of soda.—*Journal de Pharm.*

Manufacture of Salt.—At the Royal Institution, on March 21, 1835, Mr. Cartmael gave an account of some modern improvements in the manufacture of salt. The manufacture of salt consists in evaporating the natural brine, or artificial brine formed from rock-salt, till the salt crystallizes; and the higher the temperature at which this is carried on, the finer is the salt. In the old process, rectangular flat iron pans, of a moderate size, were used as boilers; but of late very large pans have been introduced; and there is at present a salt manufactory, in which the extent of pannage is 3 miles long by 8 feet wide..

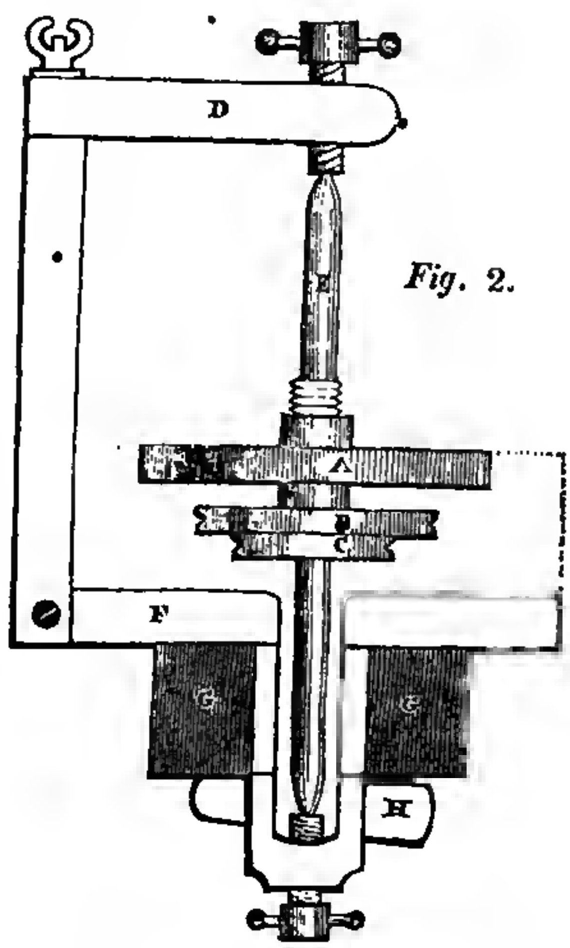
The chief improvements in the manufacture of salt consist in avoiding the evil effects of the "pan-scratch"—a technical term given to the earthy matter which used to incrust the bottom of the flat boilers and cause the rapid destruction of the iron by the fire: also in economizing the heat. To gain these ends the boilers or pans are made very long, and the fire is applied only to a part. Above the part which is over the fire a cover is fixed, which dips a little way into the boiling fluid, so that the steam which is driven off is passed through a pipe at the top of the cover, and employed in warming other pans, producing salt of inferior quality.—The bottoms of the boilers exposed to the fire are concave; and the fire being applied only to the middle, the collection of earthy matter on the heated parts of the boiler is avoided.—The hot water formed by the condensation of the steam is applied to warm fresh brine, to be admitted to the pans; and the heat of the flues from the fire is employed in a "stoving-house" to dry the manufactured salt.—*Athenæum.*

Fig. 1.



THE LAPIDARY'S APPARATUS.

Fig. 2.



POLISHING AND SLITTING STONES, GEMS, &c.

The art of the lapidary, like that of the turner, is one which is practised much by amateurs, and no doubt would be still more so were a knowledge of the requisite apparatus more widely distributed. We give this week the description of a well-contrived, complete, and easily-managed machine, for polishing stones with facility, and that it is one which any person with ordinary mechanical ability may make for their own use, will, we trust, be a further recommendation.

The polishing of stones must, at all times, be conducted by a wheel which runs horizontally, because the abrasion of their surfaces is occasioned by the attrition of some powder upon them, and not by the wearing away of the wheel itself, as is the case with a common grindstone. It is requisite also, that the surface of them should be rendered perfectly flat—the upper side of the revolving wheel, therefore, is the part necessarily employed, as it is evident that the edge would make the surface of a concave equal to the convexity of the polishing wheel. The slitting of stones, however, when done by a wheel requires that the stone should be held against the rim of it. These general observations will render more evident, and easily understood, the following explanations of the figures on the previous page.

Fig. 1.—A A represent two wheels, or discs, supported vertically, and free to move in that position; their spindles being loose from top to bottom, as is seen in Fig 2, and supported between the screws C C, (Fig. 1,) at top, and D D at bottom. B shows one of the wheels with a moveable frame around it, reaching so high as to be exactly even with the upper side of the revolving wheel. This frame, or cover, is intended to rest the stone, &c., which is to be polished upon during the operation. This part is not absolutely necessary, but its use will be found a great convenience. The other wheel is represented without its cover, that the wheels and cords communicating its motion may be more plainly seen. E is a bed, or framework, composed of two horizontal cheeks, framed together with supports, fly wheel, and treadles, exactly as in the lathe, and which will be understood without further description. F F are two wheels, fixed to the respective sides of the bed, and intended to produce an alteration in the motion from vertical to horizontal, as is seen by the cord which passes over them from the fly wheel. At G G are represented another cord, which communicates motion from the one spindle to the other; one of the wheels over which it passes is seen at H. I I shows the under part, where each wheel, and whatever belongs to it, is fixed to the bed. In the centre is seen the lower end of the spindle, and on each side of this a hole, seen near the letters I. Into these are driven wedges which fasten the whole firmly together—but so that each may be removed backwards and forwards on the bed when necessary, as it is by this means that the requisite cords are tightened. K shows a goniometer, or small machine, which may be set at any required angle by means of the rack and screw behind it, in order that when the stone is held tightly against the flat part it may be ground to any required angle.

Fig. 2 represents one of the wheels in section. A is the wheel upon which the stone is to be ground. B the pulley over which the line G, (Fig. 1,) passes. C a smaller pulley connected with the cord which passes from the fly wheel. D the frame, or elbow, at the top, E the spindle. F the frame at bottom which fixes down to the bed. G G the end section of the bed. H one of the wedges which fasten the whole together.

It is evident that the above constructions can be easily adapted to a common lathe, by having underneath the mandril two small wheels, which answering the same purpose as the wheels F F, (Fig. 1,) will convey the motion to any thing which may be fitted up to the bed of the lathe, and which will revolve vertically.

The polishing and grinding wheels are so fitted up as to be capable of being easily removed and substituted by others, hence the use of the screw and nut represented on the spindle in Fig. 2.

The wheels requisite are a very thin iron one for slitting—one of copper—one of zinc, or tin, (not iron tinned)—one of hard wood—and one or two covered with wash leather. Stones may be cut in two, or sliced by a fine wire fixed in the frame of a common saw, using diamond dust for diamonds, and tripoli for other stones.

Diamonds are to be ground with diamond powder, soaked with olive oil, upon a mill plate, or wheel, of very soft steel.

Oriental rubies, sapphires, and topazes, are cut with diamond powder, soaked with olive oil, on a copper wheel. The facets thus formed are afterwards polished on another copper wheel with tripoli, tempered with water.

Emeralds, hyacinths, amethysts, garnets, agates, and other softer stones, are slit with a wire, ground at a lead wheel with emery and water, and are polished on a tin wheel with tripoli and water, or still better, on a zinc wheel, with putty powder and water.

The more tender stones, and even the pastes, and marbles, are ground on a mill wheel of hard wood with emery and water, and are polished with tripoli and water on another wheel of hard wood.

Metals of various kinds, glass, &c., may be easily polished by the same apparatus.

MOUNTING MICROSCOPIC OBJECTS IN ALCOHOL.

The method of mounting in alcohol or spirit of wine is as follows. Take a slip of glass, and cover it on one side with a coat of painter's white lead, leaving a space in the middle large enough to contain the object to be mounted; when this coat is dry, add another, and proceed thus until a sufficient thickness is obtained for the inclosure of the object to be mounted. The next thing is to procure a clear piece of mica, free from veins and flaws, and rather smaller than the slip of glass. Fill the cavity above referred to with spirit of wine; place the object therein, and cover it with the plate of mica, which must be brought into close contact with the white lead, by gently pressing it with a smooth piece of wood from one extremity to the other, so as perfectly to expel the air-bubbles. In a few days the white lead will have become hard, and if the mica be sound, the inclosed specimen may be preserved for years. In plants it must be remembered that excepting their elementary tissues, much of their delicacy is destroyed by this method of mounting, although in many cases it is still highly desirable.

REMARKS ON GLACIERS.

BY M. AGASSIZ.

(Resumed from page 270, and concluded.)

In regard to external form, a glacier usually presents a more or less convex surface, particularly at the lower extremity. This form results from the reflection of the heat from the sides of the valley, which accelerates the melting of the ice at the edges of the glacier. When the ground on which the glacier moves, is but little inclined and free from inequalities, the surface continues regular, and the mass is not divided. But if it has some obstacle to surmount in its progress, or if the ground present one of those sudden changes of level so frequent among the Alps, the mass splits transversely into irregular leaves, moving on their lower edge as round an axis, and separated by wide crevices, which close again when the ground becomes less steep, just as the waves of a torrent again become calm after a fall. A glacier, in fact, is a river of ice stereotyped, with its cascades, rapids, storms, and calms; the superficial mass moving more quickly, and the lateral portions being influenced by the form of the bed in which it moves.

The destructive action of atmospheric agents on the mountain summits from which glaciers descend, and on the crests and declivities which border the valleys in which they move, the fall of avalanches, and the motion of the ice itself, are continually detaching along the whole basin of the glacier, fragments of rock of every size, which roll into the place which the glacier occupies, and rest upon its surface. These debris, thus deposited on and carried along with the glacier in its progress, give rise to several remarkable phenomena. The largest of these fragments, by protecting the part of the ice which they cover from the action of the sun's rays and from rain, and also from evaporation (which is often considerable, being occasioned by warm or dry winds), become, by the sinking of the rest of the surface, gradually insulated on the summit of a large pedestal or pillar of ice. This support, suffering in its turn from the action of the same agents, soon gives way; the block rolls down, and forms another pyramid at some distance. It is these that are called the *tables des glaciers*, of which fine examples are afforded by the glaciers of the Aar. If these fragments do not exceed an inch in diameter, a phenomenon of a different discription takes place. Absorbing the solar rays, by their property as opaque bodies, more rapidly than the ice, their entire mass, (not the surface merely, as in large blocks) becomes raised to a high temperature. Instead, therefore, of protecting the ice beneath them, they cause it to melt, and form holes which often penetrate to a great depth; they even pierce the glacier from one side to the other; for as long as a constant cause of heat remains at the upper orifice, the water which fills them is warmed above zero, then descends by virtue of its maximum of density to the inferior beds, where it continues to perforate the ice by slowly melting it. When we add to these phenomena the small currents of water running in every direction, uniting into torrents, and throwing themselves in cascades into the larger crevices which open or close by turns, we shall be enabled to form an idea of the perpetual movement going forward at the surface of a glacier.

These blocks scattered over the glacier, thus move along with it, and at least reaching its edges, and being continually thrown off, they accumulate and form masses of debris more or less considerable, which are named *moraines* among the Alps. These moraines are either *lateral*, disposed along the glacier parallel to its sides; or *terminal*, bounding its lower extremity, and usually describing a semicircle; or finally, *median*, forming long tracks on the surface of the interior of the glacier itself. These latter are occasioned by a union of the two lateral moraines of two glaciers descending two different gorges, and uniting in the same valley. The two glaciers never become blended, as might be supposed; each preserves its own direction and rate of progress, the line of separation being the two lateral moraines, which touch each other in such a manner as to form only one. However, when the progress of the two glaciers is very unequal, something like a division of the moraine takes place, and we then see two or three parallel tracks, as in the glacier of the Aar. These median moraines produce the phenomena of *tables des glaciers* on a large scale. Being placed at first in the depression formed by the union of the two convex surfaces of the contiguous glaciers, and protecting the ice which they cover from evaporation, they are soon elevated on a base of ice, usually in the shape of an ass's back, which, however, disappears where the moraine spreads out towards its extremity. (Glacier of the Aar.)

Let us now examine what is the action of the ice on the surface which it traverses. Here, also, we find fragments of rocks, which, by being pressed and ground, as if between the stones of a mill, are comminuted, or arrive, in the form of rounded pebbles, at the lower part, where they form the base on which the extremity of the glacier, and also the terminal moraine itself, usually rest. While moving along a rocky alterable surface, the ice, by modifying it, produces various phenomena, the principle of which are the following:

It levels it by the friction, and polishes it sometimes as perfectly as could be done by the marble-cutter, cutting the fossil bodies and concretions which it meets in its progress, and exercising its action equally upon the bottom of the bed and its sides.

It rounds off all the angles and inequalities of the ground, giving them a mammiliform appearance or transforming them into protuberances with rounded surfaces.

When the ground admits, it scoops out broad furrows, from an inch to a foot in diameter, the length of which is to the direction of the movement of the ice, and of these the surface is equally polished and the angles rubbed off. Here, also, might be mentioned spoon-shaped depressions, resembling the commencement of a furrow which has not been continued, occasioned by certain movements of the ice, for which it is difficult to account. They might be called the cuts of a chisel in the flat surface of the rock.

Particles of the hardest sand, which are always found between the ice and the rock, such as small crystals of quartz &c., produce the same effect as so many diamonds, by forming lines on these polished surfaces, which are thus covered with a multitude of rectilinear striæ parallel to each other. These striæ have no dependence on the structure of the rock: they do not follow its cleavage; they are seen to cut in two the crystals they traverse; they are always in lines of great inclination, and follow the direction which the

form of the subjacent ground has given to the ice, whether in its regular progress or accidental deviations. They cannot be attributed therefore, as has been done by Deluc, to rapid currents of water, nor to muddy currents filled with fragments of rocks, as some other observers are inclined to believe. The *debacle* of the Dent du Midi, which presented a fine example of a current of this nature, has not left any trace of this kind in any part of its course.

Finally, we perceive, on surfaces which the ice has left, other furrows, not rectilinear but undulated, often running into each other, and generally following the line of the greatest declivity. These are called *Carrenfelder* in some parts of the Alps. These furrows are evidently owing to the erosion of waters circulating beneath the glace, and gradually scooping out a bed down the declivity. Other erosions are likewise observed, exactly resembling those produced by a cascade in the place where it falls, and which probably have no other origin.

All these actions of the ice are somehat modified by the nature of the rock on which they are exercised. Granite becomes rounded in large masses, and broad convex surfaces of a pretty uniform description. The masses in limestone are smaller, and acquire the most perfect polish. It alone presents beautiful surfaces, resembling those of a slab of marble from the hands of the workman. Gneiss and the schists are more furrowed, although often in a direction transverse to their beds.

MICROSCOPIC OBJECTS.

The minute objects of creation are so numerous, and so varied, that it is extremely difficult to make a judicious arrangement of them, fully to answer the purpose of the microscopical inquirer, without appearing to descend to trivialities. The design of the present and future papers is to offer a few practical remarks upon each class of objects as they suggest themselves to our notice, and with such an arrangement as to be easily understood. We shall first treat on the microscopical illustrations offered in the vegetable kingdom, they being mostly of easy acquisition and not requiring any very powerful instrument or very nice manipulation.

Pollen is that fine dust which separates itself from the stamens or thread-like bodies, which are found next within the corolla or blossom of a flower. We are accustomed to see it as a yellow powder frequently, but it by no means always takes this color; various shades of orange, and through that to the bright browns are common, and yet to see it of a complete brown or umber color is extremely rare. Shades of purple, blue, scarlet, and flesh color are frequent. In the garden tulip it is quite black, though this color of pollen is rare, and still more so white and green; in truth we remember no plant in which either of these colors occurs—but the shape and texture are more to the microscopists' purpose. Pollen is mostly spherical, or oval, sometimes with a smooth, at others with a roughened or mamillated surface, other shapes occur, and some of them extremely curious; in plants which are by no means uncommon, thus the pollen of the St. John's wort, and the spider-wort, is formed like a long spindle, that is like an oval drawn to a point at both ends, Fig. 2.) The pollen of the lily is of the same ape, but dotted on its surface, and with a projecting line from end to end. That of the common clover is like an oblong shell; of the borage it is of the same shape, but with bright specks upon it; of the primrose and cowslip it is also oblong, but without particular markings; that of the violet resembling a brick; of the comfrey plant like two globes united; of the jonquil kidney-shaped. The pollen of the Spanish broom is curiously belted; of the tuberose somewhat triangular, and of the phlox still more decidedly so, and with a round ball upon each point. Such remarks as these might be multiplied almost without end. The following list contains many which are well worth examination, either from their shape, or the markings on their surfaces.

Lopezia.	Orchideous Plants.
Euphorbia.	Sunflower.
Acanthus.	Convolvulus.
Campanula.	Pompion.
Calla.	Geranium.
Pimpernel.	Scarlet Sage.
Hollyoak.	Thrift.
Larkspur.	Tulip.
Lychnis, Scarlet.	Fox-glove.
Mallow.	Arbutus.
Malope trifida.	Moth Mullein.
Marvel of Peru.	Nettle.
Nettle.	Poppy.
Pink.	Turk's-Cap Lily.
Passion Flower.	Jasmine.
Mignionette.	Fuschia.
Cucumber.	Pine Tree.

The organization visible in the pollen of different plants is varied, and much more complicated than we might at first suppose. The pollen, for example, of the pinus sylvestris, or Scotch fir, is divided into four cells of which the two lateral ones present a yellow packet at their extremities, while the anterior one is transparent, and the posterior one white and opaque. The grains of the grass tribe appear to have a central packet of still smaller grains, although they themselves are not more than the two-thousands five-hundredth part of an inch in diameter. The pollen of the field convolvulus appears to consist of six cells—of which three are opaque, and three transparent, looking, therefore, like a parti-colored ball. The hybiscus scriacus has its pollen grains covered apparently with thick short hairs. The organization of the marvel of Peru is like the cells of a honey-comb.

Raspail in his "Organic Chemistry" asserts, that each grain of pollen is in its young state attached to the inner surface of the anther by a fine thread or gut, which botanists have taken for interlacing filaments disposed at random; and also that the point of union of these to the grains may be easily discerned, forming as in seeds a complete hilum, or scar. He says, "by making a grain of pollen revolve in the water of an object holder, it is easy to observe the hilum, as it passes before the eye, sometimes carrying with it a fragment of the cellular texture; but to prove it more plainly, it is necessary to place a grain of pollen in sulphuric acid, which dissolving the opaque substance contained in it, without attacking its involucrum, allows the opening of the hilum to be distinctly seen."

The organic structure of pollen requires rather a high power, and it must be mounted as a transparent object, or rather placed in water, alcohol, ether, or acid. Its shape is best seen by the light reflected from the silver cup, or reflector usually attached to

microscopes, and with a very moderate power. With the Stanhope lens it may be viewed with much advantage, it being only necessary to touch one end of the lens against the anthers of any flower when expanded, which will collect a sufficiency of the fine dust.

8 9 10 11 12 13 14

The above figures illustrate some of the forms of farina, or pollen. 1, pollen of the sun-flower. 2, ditto of the St. John's wort. 3, ditto of the euphorbia, or milkwort. 4, ditto of the tuberose. 5, ditto of the sycamore tree. 6, ditto of the primrose. 7, ditto of the pink. 8, ditto of the canterbury bell. 9, ditto of the violet. 10, ditto of the bugloss. 11, ditto of the phlox. 12, ditto of many species of the orchis tribe. 13, ditto of the comfrey. 14, ditto of the ruppia.

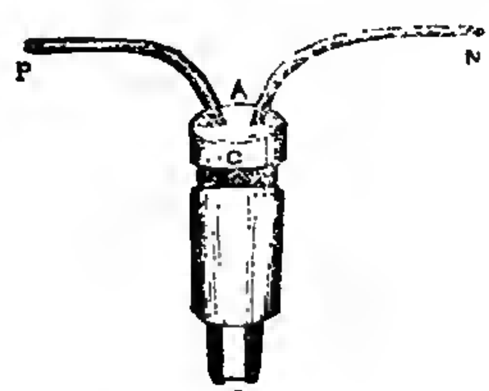
BLOWING UP OF THE ROYAL GEORGE.

The melancholy fate of this fine vessel, which suddenly went down with all on board, at Portsmouth, June the 28th, 1782, by which calamity Admiral Kempenfelt, with 900 persons were lost, has been thrust upon the public attention, for some months past, by the successful attempts of Col. Pasley to remove the remains of the hulk from its situation, where it much impedes the safe navigation of vessels into the harbour of Portsmouth, as well as those which sail along the coast. The method of accomplishing this is blowing the vessel to pieces. The material employed is gunpowder, and the agent to inflame it galvanism—an agent which has been found invariably successful, infinitely more so than the conveyance of the common electrical shock, which was suggested and somewhat put to trial by Mr. Harris some years since.

We have been led to this subject now because although all the daily prints and weekly magazines have echoed each other in what has been done, yet the method of it has hitherto been left unexplained. The firing of gunpowder by common electricity we explained in No. 19, page 148; and it was there seen that the fluid acted independent of any assistant agent, which occasioned the ignition of the powder; in galvanism, another principle is acted upon. It being known that a galvanic shock, (that is, a stream of the fluid) when made to pass through a fine platina wire, raises the temperature of the wire, so that it becomes of a white heat, and sufficient to inflame gunpowder—which it does so effectually, that when the apparatus is in good order, no possible disappointment in this part of the experiment can arise. The galvanic battery is contained in a boat, moored about 500 feet distant from the perpendicular of the hulk. Two ropes, (which are made as follows,) proceeds from the boat to the cylinder of powder. A copper wire is carefully covered with cotton, this is coated well with caoutchouc, or Indian rubber, which therefore forms a tube around it, capable of preventing the contact of the water and the wire, that thus the shock may be in no degree diminished. To keep these prepared wires from breaking by tension or casual injury each is inclosed in the centre of three ropes, which are bound tightly together throughout their whole length by rope yarn being twisted round them, and during the process of twisting, &c., tar is liberally used, which they of course soak up until saturated. The cylinder containing the explosive material is a strong tin or iron case, capable of holding from 20 to 1200 lbs. of powder—of resisting every external pressure, and yet not so strong as to diminish, except in a very small degree, the force of the explosion, and above all things water-tight. This is the larger cylinder, to which a smaller cylinder containing only a pound or two of powder is affixed. It is into this latter vessel that the wires from the battery are conveyed. The manner of their attachment to the platina wire is seen in the following cut, where P and N represent the two poles of the battery, and A the wire which connects them. The outer frame is supposed to be a section of the small cylinder above mentioned, and in which the powder surrounds the wire, and is also connected by uninterrupted communication with the larger quantity in the other vessel.

The cylinders being prepared are carefully lowered to the bottom of the sea, and by the assistance of the divers, attached to a convenient part of the hulk. The instant the two poles of the battery in the boat above are placed in contact with each other, the shock passes, and the explosion ensues. By these unerring means in a short time the anchorage off Spithead will be cleared from the great impediment which has existed there so long, and which there was no means of removal until the science of galvanism lent its powerful and certain aid.

The progress that has already been made, and also a cursory remark or two will be seen in an extract from a letter inserted in *The Times* a few days back by Col. Pasley, and which is attached. In addition to which it may be remarked, that the total quantity of powder consumed has been 12,940 lbs., and that the articles recovered have more than paid all expenses attending the operations.



B

The above cut shows another arrangement of the wires, which is found more convenient in many circumstances, particularly in the blasting of rocks, it is also exactly the same apparatus which is used when inflaming a bladder of hydrogen gas by a common electrical shock, the fine wire at the bottom being only removed. A represents a round

plug of baked wood, or better than this, ivory which in galvanic blasting is driven tightly in the rock, a hole being previously bored and filled with gunpowder. P and N are the two requisite wires passing through the wood and connected with the fine platina wire at the lower end. C represents a groove necessary to tie the bladder of gas to the plug when used for the electrical purpose mentioned above, but not necessary when used for the other purpose.

Extract from Colonel Pasley's Letter.

"We have recovered 12 guns, 5 gun carriages, 100 beams and riders, or large fragments of them, exclusive of other timbers, planks, and copper, besides the cooking place and boilers complete—the stem and great part of the bows on each side of it—the two capstans—part of the main-mast—and all that remained of the fore-mast.

"The divers informed me, soon after we commenced our operations in August last, that on going down to the bottom outside of the wreck, on a calm day, when the sun shines, they can just distinguish the outline of it as a dark mass, but nothing more.

"No part of the Royal George ever rose to the surface after our explosions, except some large fragments of the main-mast, which were immediately recovered by the boats on duty, and carried into the dock-yard, and no barnacles were found on any part of the wreck, to which a number of oysters, and *actineæ*, or sea anemonies, only, had attached themselves in great abundance."—*Times. Nov.* 19.

PURPLE OF CASSIUS.

Purple of Cassius, (Gold purple,) is a vitrifiable pigment, which stains glass and porcelain of a beautiful red or purple hue. Its preparation has been deemed a process of such nicety, as to be liable to fail in the most experienced hands. The following observations will, I hope, place the subject upon a surer footing.

The proper pigment can be obtained only by adding to a neutral muriate of gold a mixture of the protochloride and perchloride of tin. Every thing depends upon this intermediate state of the tin; for the protochloride does not afford, even with a concentrated solution of gold, either a chesnut-brown, a blue, a green, a metallic precipitate, or one of a purple tone; the perchloride occasions no precipitate whatever, whether the solution of gold be strong or dilute: but properly a neutral mixture of 1 part of crystallized protochloride of tin, with 2 parts of crystallized perchloride, produces, with 1 part of crystallized chloride of gold (all being in solution), a beautiful purple-colored precipitate. An excess of the protosalt of tin gives a yellow, blue, or green cast; an excess of the persalt gives a red and violet cast; an excess in the gold salt occasions, with heat (but not otherwise), a change from the violet and chesnut-brown precipitate into red. According to Fuchs, a solution of the sesquioxide of tin in muriatic acid, or of the sesquichloride in water, serves the same purpose, when dropped into a very dilute solution of gold.

Buisson prepares gold-purple in the following way. He dissolves, first, 1 gramme of the best tin in a sufficient quantity of muriatic acid, taking care that the solution is neutral; next, 2 grammes of tin in aqua regia, composed of 3 pars of nitric acid, and 1 part of muriatic, so that the solution can contain no protoxide; lastly, 7 grammes of fine gold in a mixture of 1 part of nitric acid, and 6 of muriatic, observing to make the solution neutral. This solution of gold being diluted with 3½ litres of water (about 3 quarts), the solution of the perchloride of tin is to be added at once, and afterwards that of the protochloride, drop by drop, till the precipitate thereby formed acquires the wished-for tone; after which it should be edulcorated by washing, as quickly as possible.

Frick gives the following prescription:—Let tin be set to dissolve in very dilute aqua regia without heat, till the fluid becomes faintly opalescent, when the metal must be taken out, and weighed. The liquor is to be diluted largely with water, and a definite weight of a dilute solution of gold, and dilute sulphuric acid, is to be simultaneously stirred into the nitro-muriate of tin. The quantity of solution of gold to be poured into the tin liquor must be such, that the gold in the one is to the tin in the other in the ratio of 36 to 10.

Gold-purple becomes brighter when it is dry, but appears still as a dirty-brown powder. Muriatic acid takes the tin out of the fresh-made precipitate, and leaves the gold either in the state of metal or of a blue powder. At a temperature between 212° and 300° Fahr., mercury dissolves out all the gold from the ordinary purple of Cassius.

Relative to the constitution of gold-purple, two views are entertained: according to the first, the gold is associated in the metallic state along with the oxide of tin; according to the second, the gold exists as a purple oxide along with the sesquioxide or peroxide of tin. Its composition is differently reported by different chemists. The constituents, according to—

		Gold.	Tin oxide.
Oberkampf, in the purple precipitate, are	-	39·82	60·18
	violet ditto	20·58	79·42
Berzelius	-	30·725	69·275
Buisson	-	30·19	69·81
Gay Lussac	-	30·89	69·11
Fuchs	-	17·87	82·13

If to a mixture of protochloride of tin, and perchloride of iron, a properly diluted solution of gold be added, a very beautiful purple precipitate of Cassius will immediately fall, while the iron will be left in the liquid in the state of a protochloride. The purple thus prepared keeps in the air for a long time without alteration. Mercury does not precipitate from it the smallest trace of gold.

YEAST.

Yeast is the barm or froth which rises in beer, and other malt liquors, during a state of fermentation. When thrown up by one quantity of malt or vinous liquid, it may be preserved to be put into another, at a future period; on which it will exert a similar fermentative action. Yeast is likewise used in the making of bread, which without such an addition would be heavy and unwholesome.

It has a vinous, sour odour; a bitter taste, arising from the hops in the malt liquor; and it reddens the vegetable blues. When it is filtered, a matter remains which possesses properties similar to vegetable gluten, by this separation the yeast loses the property of exciting fermentation, but recovers it again when the gluten is added. The addition of yeast to any vegetable substance, containing sac-

charine matter, excites fermentation by generating a quantity of carbonic acid gas. This very useful substance cannot be always procured conveniently from malt liquors for baking and brewing; the following methods will be found useful for its extemporaneous preparation.

First Method.—Mix two quarts of soft water with wheat flour, to the consistence of thick gruel, boil it gently for half an hour, and when almost cold, stir into it half a pound of sugar and four spoonsfull of good yeast. Put the whole into a large jug, or earthen vessel, with a narrow top, and place it before the fire, so that it may, by a moderate heat, ferment. The fermentation will throw up a thin liquor, which pour off and throw away; keep the remainder for use, (in a cool place,) in a bottle, or jug tied over. The same quantity of this, as of common yeast, will suffice to bake or brew with. Four spoonsfull of this yeast will make a fresh quantity as before, and the stock may be always kept up, by fermenting the new with the remainder of the former quantity.

Another Method.—Take six quarts of soft water and two handsfull of wheaten meal or barley; stir the latter in the water before the mixture is placed over the fire, where it must boil till two-thirds are evaporated. When this decoction becomes cool, incorporate with it, by means of a whisk, two drams of salt of tartar, and one dram of cream of tartar, previously mixed. The whole should now be kept in a warm place. Thus, a very strong yeast for brewing, distilling, and baking, may be obtained. For the last-mentioned purpose, however, it ought to be diluted with pure water, and passed through a sieve, before it is kneaded with the dough, in order to deprive it of its alkaline taste.

In countries where yeast is scarce, it is a common practice to twist hazel-twigs so as to be full of chinks, and then to steep them in ale-yeast during fermentation. The twigs are then hung up to dry, and at the next brewing they are put into the wort instead of yeast. In Italy the chips are frequently put into turbid wine, for the purpose of clearing it: this is effected in about twenty-four hours.

Yeast Cakes.—In Long Island, America, they are in the habit of making yeast cakes once a year. These are dissolved and mixed with the dough, which it raises in such a manner as to form it into most excellent bread. The following is the method in which these cakes are made:—rub three ounces of hops so as to separate them, and then put them into a gallon of boiling water, where they are to boil for half an hour. Now strain the liquor through a fine sieve into an earthen vessel, and while it is hot put in three pounds and a half of rye flour; stirring the liquor well and quickly as the flour is put in. When it becomes as cool as wort for brewing, add half a pint of good yeast. On the following day, whilst the mixture is fermenting or working, stir well into it seven pounds of Indian corn meal, this will render the whole mass stiff like dough; this dough is to be well kneaded and rolled out into cakes about a third of an inch in thickness. These cakes are to be cut out into large discs or lozenges, or any other shape, by an inverted tumbler or other instrument, and being placed on a sheet of tinned iron, or on a piece of board, are to be dried by the heat of the sun. If care be taken that they are frequently turned, and that they receive no wet or moisture, they will become as hard as ship-biscuit, and may be kept in a bag or box, which is to be hung up, or kept in an airy and perfectly dry situation. When bread is to be made, two cakes of the above mentioned thickness, and about three inches in diameter, are to be broken and put into hot water, where they are to remain all night, the vessel standing near the fire. In the morning they will be entirely dissolved, and then the mixture is to be employed in setting the sponge in the same way that beer yeast is used.

In making a further supply for the next year, beer or ale yeast may be used as before; but this is not necessary where a cake of the old stock remains, this acting on the new mixture in precisely the same way. If the dry cakes were reduced to powder in a mortar the same results would take place with perhaps more convenience and less loss of time. Regarding the employment of Indian meal, it is used because it is of a less adhesive nature than wheaten flour, but where Indian meal cannot easily be procured, white pea meal, or even barley meal, will answer the purpose equally well. The principal art, or requisite, in making yeast cakes, consists in drying them quickly and well, and in preventing them from coming in contact with the least particle of moisture until they are used.

FORMATION OF PEARLS.

Pearls are found in a shell fish of the oyster kind, but the formation of them has puzzled both ancient and modern naturalists, and has given occasion to several hypotheses. Pliny, Solinus, and others of the ancients, suppose them formed of the dew which (they say) the fish rises every morning to the surface of the water, and opens its shell to imbibe; but this is manifestly false, the pearl oysters growing fast to the rocks, and never rising to the surface. Others will have pearl to be the eggs of the fishes that produce them, but this does not consist with the phenomena, for they are found through the whole substance of the oyster: in the head, the coat that covers it, the stomach, and in general in all the fleshy and musculous parts, so that there is no reason to think that the pearls should be in oysters what eggs and spawn are in fowls and fishes. This indeed may be said, that there is a multitude of little eggs in form of seed, some whereof grow and ripen, whilst the rest continue nearly in the same state, so in each oyster one pearl is usually found larger than the rest, and which ripens faster than the others; and sometimes this grows so large as to hinder the oyster from shutting, in which case the fish rots and dies.

In the memoirs of the French Academy, M. Reaumer as a very curious paper on the formation both of shells and pearls; where he observes, that pearls are formed like stones in other animals, as those of the bladder, kidneys, &c., and that they are apparently the effects of a disease in the fish, deriving their origin from juices extravasated out of some broken vessels, and detained and fixed among the membranes. To evince the possibility of this, he shows that the shells of sea fishes as well as those of snails, &c., are wholly formed of a glutinous strong matter oozing out of the body of the animal; and therefore it is no wonder that such animals as have vessels containing a sufficient quantity of strong matter to build and extend the shell, should have enough to form stones in case the juice destined for the growth of the shell should happen to overflow,

and hurst forth on any cevity of the hody, or emong the memhranes. To confirm this system, he ohserves thet the inner surface of the common pearl muscle is of a mother-of-pearl color in one part, end reddish in another; and the pearls found in this ere likewise of two colors, exactly corresponding with those of the shell, which shows thet in the same place wherein the transpiration of e certain juice had formed e cost or layer of shell of a certain color, the vessels which conveyed thet juice heing hroke, e little mass or collection of it is formed, end, hardening, becomes a pearl of the same color with thet of the shell to which it corresponds. Pearls heve this advantage over precious stones dug out of rocks, that the latter owe their lustra to the industry of men, hut the former are born with that beautiful water which gives them their value. They ara found perfectly polished in the ebyss of the see, and nature has put the last hand to them ere they are separated from their mother.

There is a curious method of making counterfeit pearls, which was discovared hy the Sieur Janin, and seems worthy to he described. This artist having ohserved thet the scales of the little fish called the hleak, hed not only all the lustre of the real pearl, hut that after heeting them to powder in water, they returned to their former hrilliancy upon drying, he hethought of setting a little mass thereof in the cavity of a head, made of a kind of opal, or glass, which had likewise a pearly color. For this purpose he made use of a glass tuhe ahout six inches long, sharp at one end, and somewhat crooked, through which he hlowed a drop of the matter into the head, and to spreed it equally throughout the inner circumference, shook it gently a long time in a hasket lined with paper. The pulverized scales fastened hy this motion to the inside of the bead, resume their lustre as they dry, end nothing remains hut to stop up the eperture, which is done hy melted wax conveyed into it with a tuhe like thet used in introducing the dissolved scales. The superfluous wax heing cleared awsy, the beads were perforated end strung, end then formed into necklaces.

To the Editor.

SIR.—I send you an eccount of e scorpion, found eliva hy some workmen when unloading some timher (logwood) from Cuha, at Howley Quey, near this town, in August last; as soon as discovered it was sent to a person from whom I had the following. J. G. R. RYLANDS.

Warrington.

"When I received the scorpion I mentioned to you it appeared much exhausted; thinking it was chilled, I took it into the green-house, where it was exposed to the full glare of the sun, et ehout eleven, A.M. this hsd littla effect on it; I then thought it might want food, and leming e hive-hee, dropped it upon the scorpion's hack, upon which, hy the epplication of tha spur at the extremity of its tail, it threw the bee to the distance of eight inches or a foot, making grest exertions to escape, it also exhibited great fear whenever the hee was put near it.

"After this it sppesred totally exhausted, and thinking again that it was cold, I put it into e sheet of writing paper, and covering it with e bell glass, again exposed it to the sun, it remained soma time without moving; on putting e large house fly near it, however, without the least symptom of fear, the scorpion pressed it to its mouth, hut did not afterwards move; in about a quarter of an hour it was again looked at, and was found quite dead."*

* This and the former exposure, no doubt, hastened its death. The habits of the scorpion are, in a great measure, nocturnal, and when it does come out in the day time it keeps in the deepest shede. A demp, werm, and shady position would, therefore, have been the most proper one in which to have placed it.

MISCELLANIES.

Liquid Leather.—A Dr. Bernland, of Larrie, in Germany, is said to have discovered a method of making leather out of certein refuse and waste animal suhstances. A manufactory of this nature has heen estahlished near Vienna. No part of the process is explained, only it is said that the suhstance is at one time in a complete state of fluidity, and may then he cast into shoes, hoots, &c.

To make Black Chalk.—Chalk or chercoel, is first to he sawed in 3-inch lengths, free from knots; then saw them longitudinally in narrow strips. Procure a tin trough, about 4 inches hy 3, and partly fill it with white wax; and, after properly melted. the pieces of chercoal ara to he setureted for 48 hours, and, after draining, they ere fit for use.

New Minim Measure.—At a late meeting of the Medico-Botanical Society, a new minim measure was exhihited, the invention of e gentlemen of the neme of Alsop, residing in Sloane Square, Chelsea. It consists of a graduated glass tuhe, with a large opening at the upper end, and e emaller or capillary one at its lower extremity. It is worked hy a piston, which fits closely to the sides of the tuba, hut does not come down close to the lower orifice, there heing, therefore, a column of eir hetween it and the opeing. In order to use it, the lower end is immersed in the fluid of which some minims are required, and the piston pulled up; the column of air rises also, and, a vacuum heing thus caused, the fluid enters. It is now to be exemined, and if too much fluid hss entered, depressing tha piston gently will enshle the operator to expel e few drops, until he has ohtained the required quentity. If there be too little, he must, of course, re-immerse it, and repeat the proceeding just described. The advantage of the piston not reaching to the lower orifice is, thet a column of eir is left hetween it and the opening, which rises when the instrument is used, intervening between the fluid end the lower end of the piston, and thus preventa any of the medicine edhering to it, which, in soma cases, as whera hydrocyanic acid, &c. are employed, might he injurious. The instrument is cleaned in the same way that fluids are measured, hy drawing up e quantity of weter into it.—*Athenæum.*

QUERIES.

141—How is brass bronzed, and also cleaned for lacquering? *Answered on page* 398.

142—If a plummet be suspended over the side of a mountain would it be attracted out of its perpendicularity? *Answered on page* 413.

143—What is the easiest construction of an electrical bottle which may be charged by an excited ribbon?

144—How are glasses put in the rims of spectacles? In the same way as watch glasses are put into their rims.

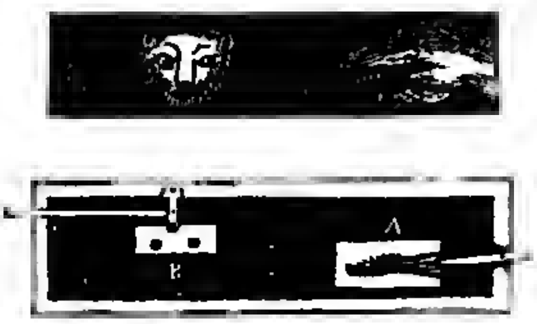
145—How are the Protean pictures, which represent one view by day, and another by night, painted and managed? *Answered on page* 227.

146—What is the method of making the Chinese artificial fire-works? *Answered on page* 297.

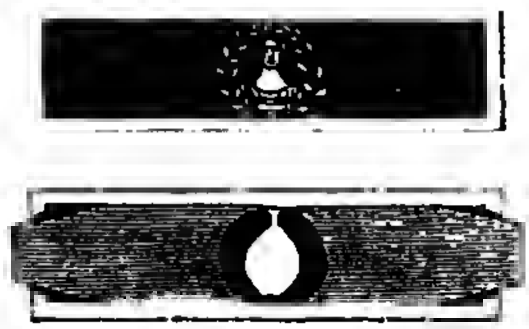
147—How is lacquer for brass and tin-ware made? *Answered on page* 312.

Fig. 1.

3.



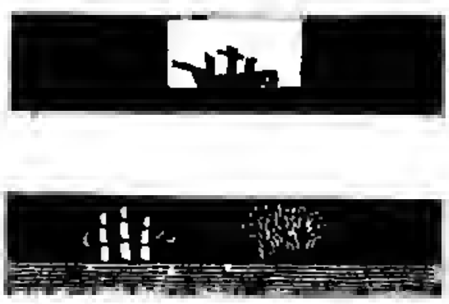
4.



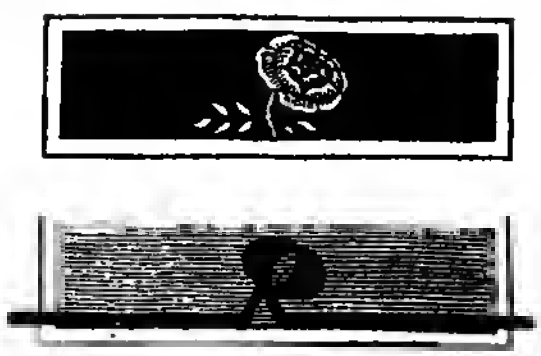
5.

MOVEABLE MAGIC LANTHORN SLIDERS.

6.



7.



8.

MOVEABLE MAGIC LANTHORN SLIDERS.

The sliders usually employed for the magic lanthorn are formed of an ordinary piece of glass, surrounded by a slight frame, altogether being at the largest 4 inches wide by 12 or 14 long, and varying from this size to any smaller dimensions, according as the lanthorn may require: for moveable sliders the size should vary according to circumstances which will readily suggest themselves to those who would make them for their own use.

The subjects, it need not be said, are extremely various—views, grotesques, processions, and allegorical subjects are but among the number, and these with numerous others may be represented with effect without implying any peculiar contrivance or construction of the apparatus, but that is not the case with others:—objects may be made to appear and disappear, to increase or diminish, to move and alter their position, and to represent the same object under various circumstances; these various improvements are occasioned by what are called *moveable sliders*, and to explain the method of arranging some of them is our present object; before entering into which, however, it may be useful to observe, that those glasses which are blackened all over, except where the objects are to be seen, are called phantasmagoreal glasses, and those of which the glass is left translucent, are called magic lanthorn glasses.

Landscape Glass.—This properly is not a moveable slider, but one on which several views are painted, in such a manner that the one is very readily substituted for the other, without changing the glass, but merely pushing it forwards a certain space; glasses of this kind are used by Mr. Childe. Fig. 1, represents a glass of this description, in which are seen four distinct views, separated from each other by a lighthouse, tree, and ruin.

Storm Glass.—The various gradations of light, as from night till mid-day, and also from calmness to storm is easily imitated; as follows, suppose Fig. 2 to be a common slider, painted to represent calmness at one end, both of sky and sea; a little further along it both should appear a little ruffled; still further on more so, and near the other end stormy and tempestuous; this being drawn through the nozzle of the lanthorn would of course represent a gradation of weather, from one extreme state to that of the other; if now a piece of glass be taken, upon which ships are drawn, as in the other glass represented, and this made to slide at the back of the former, it would of course represent those vessels in quiet at one time, and in danger another; so also, suppose the vessel to remain at rest, and the weather glass to be put in motion, a variety of the effect will ensue.

Upon the same principle one glass may represent a landscape, and a second, all the gradations of light, from the brightest day-light to the densest gloom, or the quiet of a moonlight view; a fine effect may be produced by the aid of a third glass representing moving figures, such as countrymen going home, banditti, gipsies, &c., who may by a very little contrivance have their fire and camp kettle. The way in which a second glass is fixed, and made to work easily, is this: let the view, Fig. 3, be the glass in a frame, cut away the frame at each end, so that it shall be even with the glass, except the thickness of a card, and fasten along the glass from end to end two narrow strips of card, one at the top, the other at the bottom. The glass which is to move is to be cut of such a size as exactly to run between the upper and under frame, and upon the strips of card; they may be prevented falling out by a fine pin or two driven close to their outer surface into the frame.

Sliders in which the Eyes, &c. move.—Fig. 4 will explain this readily: upon one glass are seen two animals' heads, one to move its eyes, the other its mouth; the way in which the motions are caused is easily managed,—at A is seen a white space upon which is painted a lower jaw, this is a bit of talc, and must in reality be painted *black*, except where the jaw, comes, and a hole corresponding to it left white in the perfect slider; the talc bearing the lower jaw is capable of moving up and down, by means of the slight lever fastened from it to the frame, and projecting from it a short distance beyond; as this projection is moved up and down, so will the jaw in still greater proportion. The motion of the eyes is seen in B, where the piece of talc is left white, the eyes painted black, and drawn backwards and forwards by the side lever; to prevent them moving too far either one way or the other, a stud must be put on each side of the talc or of the lever; this may be a drop of wax upon the glass itself, or anything else which, under particular circumstances, may be more convenient.

Double Sliders.—These are made by two pieces of glass put behind a fixed slider in a frame, so that they shall meet in the centre. One of the most common applications is where a bust of some noted character is seen first without extraneous ornament, and afterwards with a wreath of laurel around it. Upon the fixed glass, Fig. 5, is painted a bust with a wreath around it as represented; the two pieces of glass placed behind it have black patches painted on them, so that when pushed close together the patches cover over the wreath, and, of course, conceal it from view; when these are separated, by drawing each outwards towards the end, the wreath is exposed. Glasses with single sliders of this description are easily made—for example, a man with a lathered chin may be represented, and a barber standing over him, his hand and razor may thus be easily and effectually made to display the requisite motion.

Change of attitude is thus to be managed, see Fig. 6; paint upon a common slider in a frame a man with four arms and four legs, furnish it with two sliders at back, as in the last experiment, and paint upon these eight black patches, (four only are seen in our view); when the sliders are in one position these patches cover over two of the legs and two of the arms, when they are altered in position they cover over the other legs and arms, but at the same time display the former. Many very laughable sliders are made upon this principle, as a man dancing on a tight rope, a clown in various antics, a man thrown over his horse's head, and numerous others.

A Ship Sailing, on Fire, and a Hulk, is easily managed, but upon a still different principle. See Fig. 7. First, suppose on the fixed slider you paint a hulk, with white around it, and at the back of it place a long single slider, painted black except the lower part, even with the top of the hulk, which is to be white all along, and also at two places of the upper part, so painted as at one to represent the rigging and sails of a ship on a black ground, and at the other place the same space: but painted with the

masts, sails, burning, &c., also on a black ground; the space beneath may be tinged with red, to throw a reflection on the hulk and water. Put the slider so that the first shall appear over the hulk, and the ship will be seen in full glory, and perfect; suddenly change to the next and the ship will seem on fire; again change the view, and put a black part of the slider over the ship and she will seem but a wreck, dismasted and sinking.

The *Expanding Rose*, see Fig. 8.—This is a very effective design. Paint on a fixed slider a rose, fully expanded, with, if, you please, leaves, stem, &c., and place behind it two sliders made of talc, or thin brass, or tin, so that they will open in the segment of a circle, open these by two levers, as seen in the second part of our figure, pushing each lever forwards, which, as they are supported in the middle by pivots, will expand the upper part of them, in the same degree as the lower part is closed, then the rose, which at first was so shut up by the sliders as to appear but a bud, will seem to expand gradually. This effect may be obtained by simple double sliders, as in the head with the wreath, but it is infinitely less natural than the above. In one of the views of Mr. Childe, a Cupid appears to issue from the rose, but this is occasioned by the assistance of a second magic lanthorn; such also is the case with the figure of Fame dropping a wreath, &c.

We could have wished to have extended these remarks to other objects and cases, particularly to Mr. Childe's exhibition, but cannot do so because we forget the various changes which he exhibits. We have, however, some remarks to make at a future time on astronomical sliders, and *artificial fire-works* and also on the general management of the magic lanthorn.

GLASS-BLOWING

(Resumed from page 270, and concluded.)

Bending.—If the tube is narrow, and the sides are pretty thick, this operation presents no difficulty. You heat the tube, but not too much, lest it become deformed; a *reddish brown* heat is sufficient, for at that temperature it gives way to the slightest effort you make to bend it. You should, as much as possible, avoid making the bend too abrupt. For this purpose, you heat a zone of one or two inches in extent at once, by moving the tube backwards and forwards in the flame, and you take care to bend it very gradually.

But if the tube is large, or its sides are thin, and you bend it without proper precautions, the force you employ entirely destroys its cylindrical form, and the bent part exhibits nothing but a double flattening—a canal, more or less compressed.

To avoid this deformity it is necessary, first, to seal the tube at one extremity, and then, while giving it a certain curvature, to blow cautiously by the other extremity, which, for convenience sake, should previously be drawn out. When tubes have been deformed by bad bending, as above described, you may, by following this method, correct the fault; that is to say, upon sealing one extremity of the deformed tube, heating the flattened part, and blowing into the other extremity, you can, with care, reproduce the round form.

In general, that a curvature may be well-made, it is necessary that the side of the tube which is to form the concave part be sufficiently softened by heat to sink of itself equally in every part during the operation, while the other side be only softened to such a degree as to enable it to give way under the force applied to bend it. On this account, after having softened in a *cherry red heat* one side of the tube, you should turn the other side, which is to form the exterior, of the curvature, towards you, and then, exposing it to the point of the jet, you should bend the tube immediately upon its beginning to sink under the heat.

Soldering.—If the tubes which you propose to solder are of a small diameter, pretty equal in size, and have thick sides, it is sufficient, before joining them together, to widen them equally at their extremities, by agitating a metallic rod within them.

But if they have thin sides, or are of a large diameter, the bringing of their sides into juxtaposition is very difficult, and the method of soldering just indicated becomes insufficient. In this

very much facilitates the soldering.

Finally, when the tubes are of a very different diameter, you must draw out the extremity of the larger and cut it where the part drawn out corresponds in diameter to the tube which it is to be joined to.

When the holes are well prepared, you heat at the same time the two parts that are soldered together, and join them at the moment when they enter into fusion. You must push them slightly together, and continue to heat successively all their points of contact; whereupon the two tubes soon unite perfectly. As it is almost always necessary, when you desire the soldering to be neatly done, or the joint to be imperceptible, to terminate the operation by blowing, it is proper to prepare the extreme ends of the tubes before-hand. When the points of junction are perfectly softened, and completely incorporated with each other, you introduce a little air into the tube, which produces a swelling at the joint. As soon as this has taken place, you must gently pull the two ends of the joined tube in different directions, by which means the swelled portion at the joint is brought down to the size of the other parts of the tube, so that the whole surface becomes continuous. The soldering is then finished.

To solder a bulb or a cylinder between two points, to the extremity of a capillary tube, you cut and seal one of the points at a short distance from the bulb, and at the moment when this extremity is in fusion you pierce it by blowing strongly at the other extremity. By this means the opening of the reservoir is terminated by edges very much widened which facilitates considerably its being brought into juxta-position with the little tube. In order that the ends of the two tubes may be well incorporated the one with the other, you should keep the soldered joint for some time in the flame, and ought to blow in the tube, push the ends together and draw them asunder, until the protuberance is no longer perceptible.

If, after having joined two tubes, it should be found that there still exists an opening too considerable to be closed by simply pushing the two tubes one upon another, you can close such an opening by means of a morsel of glass, applied by presenting the fused end of an auxiliary tube.

You should avoid soldering together two different species of glass—for example, a tube of ordinary glass with a tube of flint-glass; because these two

species of glass experience a different degree of contraction upon cooling, and if joined together while in a fused state, are so violently pulled from one another as they become cool, that the cohesion of the point of soldering is infallibly overcome, and the tube breaks. You ought also, for a similar reason, to take care not to accumulate a greater mass of glass in one place then in another.

PRESERVING FUNGI.

As the present is the season when fungi abound in every situation, it may not be uninteresting to our country readers to learn their uses, and to botanists to know the mode of preparation for the herbarium adopted by Dr. Klotch and Dr. Honker, both of whom are known to have bestowed so much attention on this difficult part of botany.

Their qualities are various, many are used very extensively as articles of food, a few are endowed with valuable medicinal properties, numbers are highly poisonous, and the ravages of several in dock-yards, corn-fields, orchards, &c., are incalculable. A few possess the remarkable property of exhaling hydrogen gas. Some, however, exhale carbonic-acid gas and inhale oxygen.

In this country, *Fungi* are so generally objects of prejudice and disgust, that their real importance as useful productions is little appreciated. With the exception of the common *Mushroom*, scarcely a single species of *Agaric* is in general accurately distinguished, and though many speak of another kind, under the name *Champignon*, there are few persons who know what to gather, and the fatal mistakes which have in consequence been made, have increased the disinclination to the use of any but the *Mushroom*. *Truffels* and *Morels* are so local and scarce, that they are by no means generally known, seldom appearing at common tables, and probably the greater part of what are sold is imported. *Agaricus Georgii*, *A. personatus* and *A. procerus* are occasionally brought to Covent Garden Market, but their consumption is quite trifling. *Boletus edulis*, which is a most abundant and excellent species, is, I believe, altogether unknown, and the same may be said of several approved kinds, which on the continent, are in constant use and regularly exposed for sale. Indeed in many parts of Europe, but especially Poland and Russia, they form a most important part of the food of the common people, and in the latter country whole tribes are mainly supported by them, scarcely any species, except the *dung* and *fly Agarics*, being rejected. Even those kinds which are elsewhere refused by common consent as poisonous, on account of their extreme acridity, are taken with impunity, being extensively dried, or pickled in salt or vinegar for winter use. It is probable that this harmlessness arises from the particular mode of preparation, for from the exact account of Pallas, and the general diffusion of various species in various countries, there is no reason to doubt the fact, that sorts justly esteemed poisonous are really used; and it is well known that the noxious qualities of the most virulent species, *Agaricus vernus*, are communicated to brine, vinegar, &c., and that the *Olive-tree Agaric* loses all its poisonous properties when salted, and becomes eatable. The pickle is probably in general thrown away; while as to dried fungi, I have been informed by a gentleman of great acuteness and observation, that in some town of Poland, where he was detained as a prisoner, he amused himself with collecting and drying the various fungi which grew within its walls, amongst which were many commonly reputed dangerous, and that to his great surprise, his whole collection was devoured by the soldiers. Indeed two poisonous principles have been discovered in fungi, one of which is so fugacious that it is dispelled by heat, or the act of drying, or by immersion in acids, alkalies, or alcohol; the other is more fixed and resists such processes; and it is well observed by the late Professor Burnett, in his outlines of Botany, § 725, "in certain situations, *truffles*, *morels*, and *common mushrooms*, are nearly flavorless, while in others their grateful tastes and smells are highly developed; and in a similar way certain *fungi*, which are eatable in one country or when gathered from one situation, are deleterious when growing in another; this difference depending upon the greater or less quantity of poisonous matter formed, the production of which may be favored or suppressed by external physical circumstances, just from the same cause as *Celery* is said to be poisonous and *Sea-kale* and *Asparagus* not eatable when growing wild, but which become bland and esculent when chance or culture, by excluding light, prevents the formation of their acrid principle." It is however the practice in some districts to use *fungi* without any preparation whatever, as in their simple state they are considered more wholesome and nutritious. This practice is probably confined to kinds allied in their qualities to *Agaricus campestris*, and Schwægrichen assures us, in a letter quoted by Persoon, that in consequence of seeing the peasants about Nuremberg eating raw *mushrooms*, seasoned with anise and carraway-seed along with their black bread, he resolved to try their effect himself, and that during several weeks he ate nothing but bread and raw fungi, as *Boletus edulis*, *Agaricus campestris*, *Agaricus procerus*, &c., and drank nothing but water, when instead of finding his health affected, he rather experienced an increase of strength. A few species are recorded as used in the southern hemisphere; and a kind of *Pachyma* is known in Van Diemen's Land by the name of "*native bread.*"

The Kamtschatkans and Coriacks use *Agaricus muscarius*, or a nearly allied species, to produce intoxication, which often amounts to absolute delirium, and it is most remarkable that the narcotic property is communicated to the urine of the person who partakes of it, which is in consequence carefully preserved when the species is scarce, for the renewal of these disgusting orgies.

The medical uses of *Fungi*, are probably of far greater importance then their present very limited application might lead us to suppose. Several, which were formerly in high reputation for their active properties, are now altogether neglected or forgotten. Dufresnoy is said to have used *Agaricus emeticus* with success in the early stage of consumption, and doubtless if they were more studied, many of the active species might afford valuable remedies. However this may be, one, at, least, the *Ergat*, is a highly powerful and valuable specific, causing, as it does, a contraction of the uterus. It is most curious that this production, when occuring in great abundance among rye, as it does frequently where that grain is extensively cultivated, and unavoidably composing a considerable part of the bread, gives rise to one of the most

fearful and distressing diseases with which the human race is afflicted, in which the limbs gradually waste away with horrible pain, and eventually fall off. The same effect was produced, some years ago, in the neighbourhood of Bury St. Edmunds, upon several members of a family who had lived upon bread made from damaged wheat. In this case, however, it is not at all clearly proved that the evil effects did not rise more from decomposition of the corn than from the presence of *ergot*, a circumstance highly curious, if correct, and rendered somewhat probable by cases which have occurred of dreadful illness, from the use of bread made of musty flour, which in a few hours was infested with mould, the fungi, however, proving perfectly innocuous, though the use of the bread itself was attended by the most alarming symptoms.

(*Continued on page* 294.

PAINTING SAIL-CLOTH, &c.

This process, the account of which is extracted from the *Transactions of the Society of Arts* is now universally practised in the public dock-yards.

The paint usually laid upon canvas, hardens to such a degree as to crack, and eventually to break the canvas, which renders it unserviceable in a short time; but the canvas painted in the new manner is so superior, that all canvas used in the navy is thus prepared; and a saving of a guinea is made in every one hundred square yards of canvas so painted.

The old mode of painting canvas, was to wet the canvas and prime it with Spanish brown; then to give it a second coat of chocolate color, made by mixing Spanish brown, and black paint; and lastly, to finish it with black.

The new method is to grind 96lbs. of English ochre with boiled oil, and to add 16lbs. of black paint, which mixture forms an indifferent black. A pound of *yellow soap* dissolved in six pints of water over the fire, is mixed, while hot, with the paint. This composition is then laid upon the canvas (without being wetted, as in the usual way,) as stiff as can be conveniently done with the brush, or so as to form a smooth surface: the next day, or still better, on the second day, a second coat of ochre and black (without any, or but a very small portion of soap) is laid on, and allowing this coat an intermediate day for drying, the canvas is then finished with black paint as usual. Three days being allowed for it to dry and harden, it does not stick together when taken down, and folded in cloths containing 60 or 70 yards each; and canvas finished entirely with the composition, leaving it to dry one day between each coat, will not stick together, if laid in quantities.

It has been ascertained from actual trials, that the solution of yellow soap is a preservative to red, yellow, and black paints, when ground in oil and put into casks, as they acquire no improper hardness, and dry in a remarkable manner when laid on with the brush, without the use of the usual drying articles.

It is surprising that the adoption of soap, which is so well known to be miscible with oily substances, or at least the alkali of which it is composed, has not been brought into use in the composition of oil colors.

FROSTS.

The cause of the expansion of water during its conversion into ice is not yet well ascertained. It was supposed to have been owing to the air being set at liberty in the act of congelation which was before dissolved in the water, and the many air bubbles in ice were thought to countenance this opinion. But the great force with which ice expands during its congelation, so as to burst iron bombs and cannon, according to the experiments of Major Williams at Quebec, invalidates this idea of the cause of it.

M. de Mairan attributes the increase of bulk of frozen water to the different arrangement of the particules of it in crystallization, as they are constantly joined at an angle of 60 degrees; and must by this disposition he thinks occupy a greater volume than if they were parallel. He found the augmentation of the water during freezing to amount to one-fourteenth, one-eighteenth, one-nineteenth, and when the water was previously purged of air to only one-twenty-second part. He adds that a piece of ice, which at first was only one-fourteenth part specifically lighter than water, on being exposed some days to the frost became one-twelfth lighter then water. Hence he thinks ice by being exposed to greater cold still increases in volume, and to this attributes the bursting of ice in ponds and on glaciers.

This expansion of ice well accounts for the greater mischief done by several frosts attended with moisture, (as by hoar-frosts,) than by the dry frosts called black frost. Mr. Lawrence in a letter to Mr Bradley complains that the mist attended with a frost on a May-day had destroyed all his tender fruits; though there was a sharper frost the night before without a mist, that did him no injury; and adds, that a garden not a stone's throw from his own on a higher situation, being above the mist, had received no damage.

Mr. Hunter by very curious experiments discovered that the living principle in fish, in vegetables, and even in eggs and seeds, possesses a power of resisting congelation. There can be no doubt but that the exertions of animals to avoid the pain of cold may produce in them a greater quantity of heat, at least for a time, but that vegetables, eggs, or seeds, should possess such a quality is truly wonderful. Others have imagined that animals possess a power of preventing themselves from becoming much warmer than 98 degrees of heat when immersed in an atmosphere above that degree of heat. It is true that the increased exhalation from their bodies will in some measure cool them, as much heat is carried off by the evaporation of fluids, but this is a chemical not an animal process. The experiments made by those who continued many minutes in the air of a room heated so much above any natural atmospheric heat, do not seem conclusive, as they remained in it n less time than would have been necessary to have heated a mass of beef of the same magnitude, and circulation of the blood in living animals, by perpetually bringing new supplies of fluid to the skin, would prevent the external surface from becoming hot much sooner than the whole mass. And thirdly, there appears no power of animal bodies to produce cold in diseases, as in scarlet fever, in which the increased action of the vessels of the skin produces heat and contributes to exhaust the animal power already too much weakened.

It has been thought by many that frosts ameliorate the ground, and that they are in reality salubrious to mankind. In respect to the former it is now well known that ice or snow contain no

the clay becomes as hard as before, being pressed together by the incumbent atmosphere, and by its self-attraction, called *setting* by the potters. Add to this, that on the coast of Africa, where frost is unknown, the fertility of the soil is almost beyond our conceptions of it. In respect to the general salubrity of frosty seasons, the bills of mortality are an evidence in the negative, as in long frosts many weakly and old people perish from debility occasioned by the cold, and many classes of birds and other wild animals are benumbed by the cold, or destroyed by the consequent scarcity of food, and many tender vegetables perish from the degree of cold.

It should be objected to this doctrine that there are many moist days attended with a brisk cold wind when no visible ice appears, and which are yet more disagreeable and destructive than frosty weather. For on these days the cold moisture, which is deposited on the skin is, there evaporated, and thus produces a degree of cold perhaps greater than the milder frosts. Whence even in such days both the disagreeable sensations and insalubrious effects belong to the cause above mentioned, viz. the intensity of the cold. Add to this, that in these cold moist days, as we pass along, or as the wind blows upon us, a new sheet of cold water is as it were perpetually applied to us, and hangs upon our bodies. Now as water is 800 times denser than air, and is a much better conductor of heat, we are starved with cold like those who go into a cold bath, both with the great number of particles in contact with the skin and the greater facility of receiving our heat.

It may nevertheless be true that snows of long duration in our winters may be less injurious to vegetation than great rains and shorter frosts, for two reasons. 1. Because great rains carry down many thousand pounds worth of the best part of the manure off the lands into the sea, whereas snow dissolves more gradually and thence carries away less from the land; any one may distinguish a snow-flood from a rain flood by the transparency of the water. Hence hills or fields with considerable inclination of surface should be ploughed horizontally that the furrows may stay the water from showers till it deposits its mud. 2. Snow protects vegetables from the severity of the frost, since it is always in a state of thaw where it is in contact with the earth; as the earth's heat is about 48 degrees and the heat of thawing snow is 32 degrees, the vegetables between them are kept in a degree of heat about 40, by which means many of them are preserved.

FANCY WOODS.

(Resumed from page 253, and concluded.)

Cocos.—Under this name is included the wood produced by several species of palm tree, particularly the coco-nut palm. The wood is of a light brown, interspersed irregularly with veins, that appear like strings of a darker color. It is not used in this country except for *stringing*, that is for inlaying other larger and more ornamental woods. It is never of a large size, because the centre of the tree is soft and pithy, that which we know as the cocos wood is only sticks cut out of the main stem near its circumference. Umbrella and parasol sticks are often made of cocos.

Coquilla-wood.—This is the produce of the coquilla nut, which is about two inches in diameter, and three inches long. It is completely solid, except a small hole of about half an inch in diameter near one end of it, in which the kernel is deposited. The nut is used chiefly by the ornamental turner to form the knobs on umbrella handles, chessmen, and other similar purposes; it is extremely hard, of a fine brown color, streaked with a lighter tint, and takes a fine polish.

Walnut.—A wood once much cultivated in England, but in the time of the war, a vast number of the finest walnut trees in the kingdom were sacrificed for the manufacture of gun stocks, for which it seems particularly adapted, being of a fine brown and even color, taking a high polish, easy to be worked, yet hard and firm, and not subject to snap by the sudden concussions to which fire arms are so particularly exposed. It used before the general introduction of mahogany to be the usual wood for the better kind of furniture, and many an old cabinet is yet to be found of great beauty made of this wood. The heartwood is chiefly used for gun-stocks, the part near the bark, which botanists call the alburnum, and workmen the *sap*, is of nearly a white color: thus veneers cut through the tree show a marked contrast of colors, though they do not interlace each other sufficiently to occasion that beauty in appearance seen so conspicuously in the rose and other woods.

Yew-wood.—The stem of the yew tree when cut across shows more beautiful stripes, and a greater variety of shades than any other tree of native growth. The color of the heartwood is a fine red, and according to the age of the tree mixed with pink and brown, while the wood near the surface of the trunk is white, and as the tree is usually knotty, with irregular growth of branches, and otherwise uneven, a longitudinal section presents many fine intermixtures. The yew-tree, however, is of such very slow growth, as not to pay for culture, especially as it seldom attains a large size; its wood therefore is now little used, it being superseded by tulip wood, which it much resembles.

Teak-wood.—This is scarcely known here as an ornamental species, but in the East Indies it is of the most common occurrence; it is exceedingly lasting, grows of a very large size, is about as hard and tough as oak, and of a yellow color, though without much grain. It might with great advantage be used for the same purpose as the commoner kinds of mahogany, namely to veneer upon, as it holds glue extremely fast, and is not liable to warp by changes of heat or damp, to which it may be accidentally exposed. Indian built ships are mostly of teak.

American Walnut.—A wood under this name was imported some years since, as a substitute for the English walnut, but was found by no means equal to it in appearance. Its color is a uniform, and not very brilliant brown; what few streaks it has are straight, and of a golden yellow.

Marble Wood and *Toon Wood* are two species similar to common Honduras mahogany; the latter has no beauty whatever, unless being of a clear brown can be considered such; the former is called marble because its veins interlace each other like the veins of some of the smaller patterned marbles.

Cedar.—The wood so called, and which is universally known as a cheap substitute for mahogany, our commoner kinds of furniture being wholly made of it, as well as the inside of drawers

and other parts not exposed to sight of even the superior articles, is the produce of the *Cupressus sempervirens*. It grows abundantly in the Levant, and is considered almost imperishable, so as to have become the emblem not only of death for its dark foliage, but of immortality for the durable nature of its wood. It comes to this country in very large logs, it possesses but little beauty until highly polished or varnished, when it is easily mistaken for Honduras mahogany.

The Holly, Box, Lilac, Crab Tree, and White Thorn yield woods of little beauty of markings, but they are occasionally employed to inlay various darker kinds, and also some of them are used in considerable quantity by the turner, they are hard, not likely to split, of a white color, and take a good polish.

Laburnum.—The wood of this tree might be used with some advantage, it is hard, and of two colors, the young wood being white, the older brown, very similar to what is observed in the elm, the woods of this latter is very apt to twist or warp out of its proper form but not that of the laburnum.

Cog-wood.—This is so called because used in the West Indies to make the cogs of the sugar mills. It has not been brought to this country unless as an article of curiosity. It is one of the finest timber trees in Jamaica, growing to the height of 60 or 80 feet, and there used for all purposes where strength and durability are required. Its color is a fine green, but not durable when cut. It is the produce of one species of the Laurel, *(Laurus chloroxylon.)*

Madeira Mahogany and *Canary-wood.*—Another species, *(Laurus indica,)* produces the Madeira mahongany as it is called, a wood of a yellowish brown color, good for either building or furniture; when young it is of a fine and clear yellow, called then *Canary-wood*, it being brought first from the Canary Islands. This last wood is little used here, its principal employment being for carpenters' rules, though box or holly stained of a yellow color is often substituted.

Bourbon-wood.—The tree, which produces this fine wood, and which was named from the Bourbon family, grows abundantly in Carolina, and is well adapted for ornamental furniture. It much resembles satin-wood in appearance, but is even more lively and shining, besides which it grows to a larger size.

Camphor-wood, the produce of the *Laurus camphora*, is a white wood, of little comparative beauty, though its fragrance, and which it retains for many years, renders it admirable for chests, the inside of wardrobes, &c. as a preservative against insects consuming or injuring the contents. The tree however seldom grows above a foot in diameter.

Lance-wood is produced by the *Guatteria virgata*, a tree of the West Indies growing 30 feet in height. It is a yellowish white, hard straight-grained wood, used much for the shafts of light carriages. It is extremely elastic but not beautiful.

Milk-wood, is so called because a milky juice exudes from the trunk of the tree. It does not grow above 6 feet high, and is a native of Jamaica.

Leather-wood, so called from its resembling leather, it is produced by the *Dirca palustris*, a small shrub inhabiting the swamps of Virginia.

Cork-wood.—The stem of the custard apple tree, which is so very soft as to be universally employed by the natives of Jamaica, as corks for their calabashes, &c.

Iron-wood, called also *Lever-wood*, is so named from its hardness—for ornamental purposes it has little value. It is the trunk of the hop hornbeam, a tree exceedingly ornamental on account of the large white catkins in which its fruit is borne.

Lignum Vitæ-wood.—The *Guaiacum officinale*, produces this wood, as well as the guaicum resin of the dispensatory. The trees grow to a height of 40 or 50 feet, and are often 6 or 8 feet in circumference. The wood is of a very dark olive color, and the fibres are so interlaced with each other that it is almost impossible to split it; it takes a fine polish, turns well, and is much used for ship's blocks, not only because of its unwearing character, but because it never requires to be greased or oiled to lessen the friction of the rubbing parts, for which reason it forms also. next to metal, the best spindles for machinery.

Olive-wood, used for snuff boxes, &c., is not the root or stem of the olive tree as generally supposed, but of a North African tree called *Elæodendrum argam*. The wood is very peculiar, being of a yellow color, mottled thickly, with blackish grey knots and streaks. It grows from 12 to 15 feet high.

Many other woods might have been mentioned, and there are, no doubt, in the extensive forests of Brazil, Sumatra, and other of the tropical countries, hundreds yet to be discovered and applied to useful or ornamental purposes, but we fear to engross too large a space with this subject. It is right to mention, however, that many woods have obtained a name, not merely from having been derived from a particular tree, but from a particular part of that tree, or when it has been growing under unnatural circumstances. Thus the root of the oak tree is very different in appearance from the stem, and so is this latter when it has been *lopped* or *polled*, the head of it becoming in that instance irregularly knotted, forming what is called by painters *pollard oak wood*—so also the maple tree, thus mutilated, forms the *Birds-eye Maple*. The Willow-wood is also much altered in character by heading the trees. The Mulberry and the Acacia, though their woods are not beautiful in a natural state, yet become highly interesting when thus thrown into variegated knots and stripes.

The trees of native growth, may at a future time, be alluded to, but this concludes the article on Fancy Woods.

To the Editor.

Sir.—In an early Number of your Magazine, a correspondent complains of the devastating effects of the beetle in his cabinet. This little creature infested Sir T. Philip's library very much, and he employed himself to find out some means of ridding his bookcase of these intruders.

The larvæ of these beetles, it appears, have no appetite for either leather or paper, the paste is what they seek, so that if the paste were to be mixed up with some poisonous ingredient it would prevent their attacks. To catch the insects be recommends the following plan.

"Anobium striatum commonly deposits its ova in beech-wood. I therefore have some pieces of beech-wood cut, and smear them over in summer with paste not containing any poisonous ingredient. This wood is then placed in various parts of the library, where it is not likely to be disturbed;

the beetles soon discover end deposit their eggs in it. In winter the larva is chiefly produced, and about January, February, and March, I discover what pieces of wood contain them, by sawdust lying underneath them, or else it may be observed in little hillocks on its surface. The pieces are then consumed as fire-wood. By this simple method I have extirpated Anobia from my library. I am of opinion that a single specimen in a book of an impregnated female, would soon destroy any book, if it were to remain undisturbed." GRAPHIUS.

OIL FOR CHRONOMETERS.

BY MR. HENRY WILKINSON, OF PALL MALL.

The best olive oil, in its recent state, possesses that peculiar bland flavor which fits it for the table, and which appears to arise principally from the quantity of mucilage and water, either held in solution, or mechanically mixed with it. By keeping one or two years in jars, a considerable portion of the mucilage and water subsides, which renders such oil not only cheaper, but better qualified for yielding a greater proportion of *pure* oil than that which is recently expressed from the fruit. Two or three gallons skimmed from the surface of a large jar that has remained at rest for twelve months or upwards, is preferable to any succeeding portion from the same jar, and may be considered the cream of the oil. Having procured good oil in the first instance, put about one gallon into a cast-iron vessel capable of holding two gallons; place it over a slow, clear fire, keeping a thermometer suspended in it; and when the temperature rises to 920°, check the heat, never allowing it to exceed 230°, nor descend below 212°, for one hour, by which time the whole of the water and acetic acid will be evaporated. The oil is then exposed to a temperature of 30° to 36° for two or three days (consequently winter is preferable for the preparation, as avoiding the trouble and expense of producing artificial cold). By this operation, a considerable portion is congealed; and while in this state, pour the whole on a muslin filter, to allow the fluid portion to run through; the solid, when re-dissolved, may be used for common purposes. Lastly, the fluid portion must be filtered once or more through newly-prepared animal charcoal, grossly powdered, or rather broken, and placed on bibulous paper in a wire-frame, within a funnel: by which operation, rancidity (if any be present) is entirely removed, and the oil is rendered perfectly bright end colorless.

MISCELLANIES.

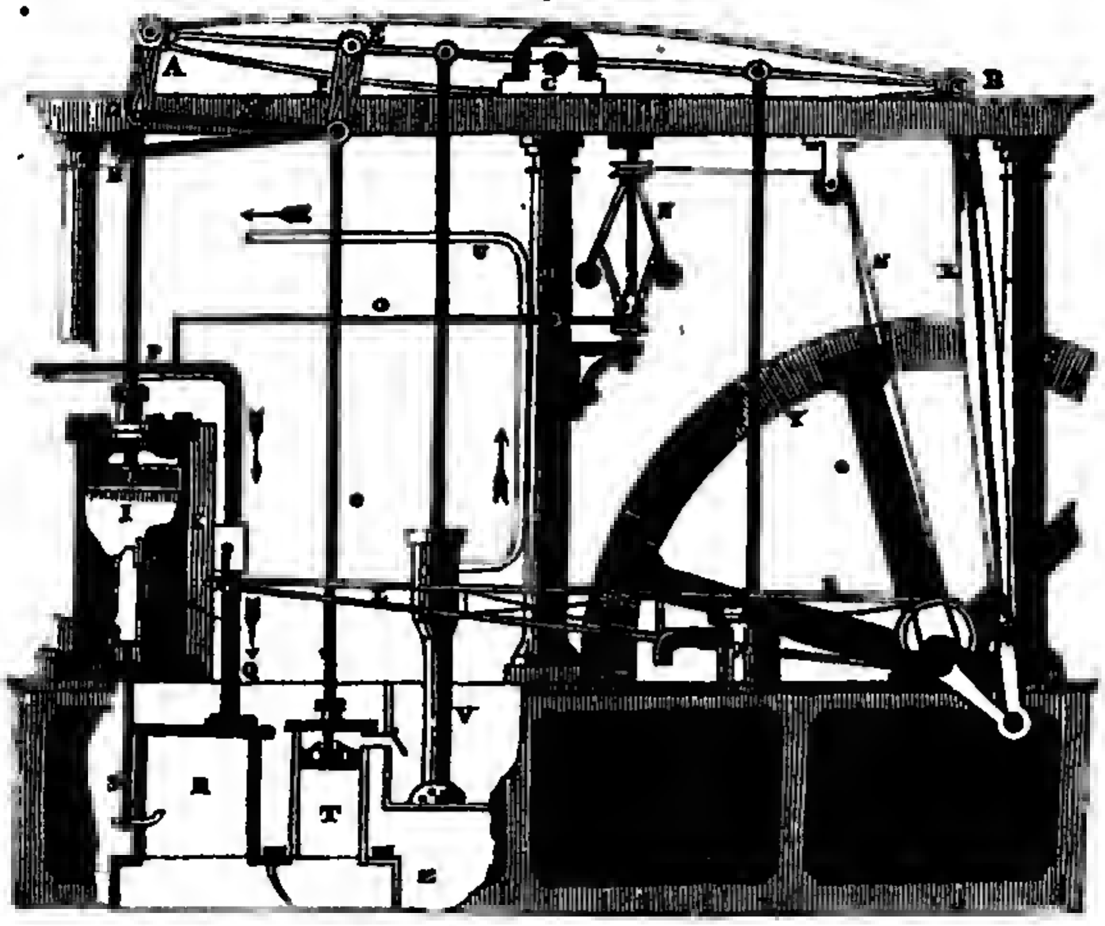
New Postage.—The weight which a letter may pass through the penny post office is half an ounce, or 218¾ grains. A half-crown of the year 1817 weighs about 208 grains, or 10¾ less than half an ounce. Two shillings and sixpence of ordinary wear will generally weigh from 3 to 6 grains less than the half-crown. An ordinary sheet of post quarto writing paper, weighs about 120 greins;—large thick post, 180; small thin post, such as is used on the Continent, about 65 grains. The ordinary quantity of wax upon a letter weighs 6 grains; 20 dips of ordinary ink, from a steel pen, weighs about 4 grains; when the moisture is evaporated, it only weighs one grain. A drop of water weighs about one grain; e letter carried in the hand, exposed to a slight shower, will gain in weight from 10 to 20 grains in 5 minutes.

The Traveller's Life Preserver.—Mr. Thomas, of St. James's Street, has perfected an invention, the object of which is to stop the progress of horses which have taken fright. The apparatus is thus described by Mr. Thomas himself:—"On the nave of the wheel is fixed a small gun-metal wheel; in front of the axle runs a steel spindle, with a small cog attached; over the spindle is a cylinder, and to which a check-string is affixed. The moment it is put in action the spindle advances, and the cog revolves gradually round the gun-metal wheel, which is fixed on the nave, carrying with it reins leading from the horse's head, composed of cat-gut, or of patent cord, covered with leather. As the wheel revolves, the cylinder, which is about an inch in diameter, is gathering up the reins, until the horse is brought to a stand-still; when, by letting loose the check-string, the horse's head is immediately free."—*Waterford Paper.*

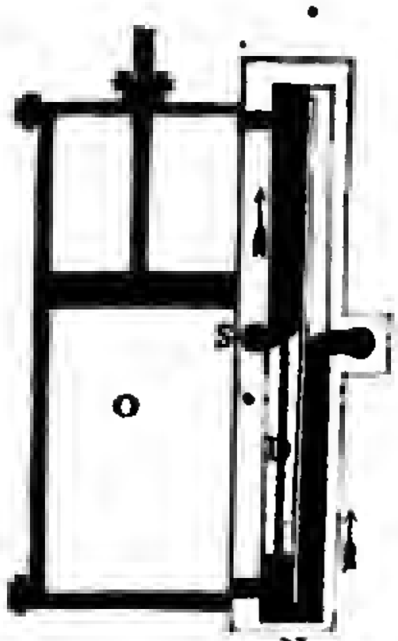
Sulphate of Quinia: Causes of its High Price.—The quantity of Peruvian bark which is imported into Europe is very considerable; but chemistry has recently proved that a large portion of the bark itself is useless. The alkali quinia which has been extracted from it, possesses all the properties for which the bark is valuable, and only forty ounces of this substance, when in combination with sulphuric acid, can be extracted from 100lbs. of the bark. In this instance, then, with every ton of useful matter, thirty-nine tons of rubbish are transported across the Atlantic. At the present time, the greatest part of the sulphate of quinia used in this country is imported from France, where the low price of the alcohol, by which it is extracted from the bark, renders the process cheap; but it cannot be doubted, that when more settled forms of government shall have given security to capital, and when advancing civilization shall have spread over the states of South America, the alkaline medicine will be extracted from the woody fibres by which its efficacy is almost lost, and that it will be exported in its most condensed form.

Bags of Wind for Raising Vessels.—We have witnessed an interesting experiment on board the revenue cutter, Hamilton, Captain Sturgis, which was intended to illustrate the practibility of raising a vessel by means of cylindrical bags placed under her bottom, and filled with atmospheric air. The bags were each of large size, capable of containing 2,500 cubic feet of air. They were confined by means of ropes passing under the keel, and afterwards filled by two forcing pumps propelling the air through tubes into the cylindrical floats. The bags were made of three parts of stout cotton canvas, made air and water tight by means of Indian-rubber, and were prepared by Mr. Howard, of Roxbury, under the direction of the inventor, Mr. M'Kean. The cutter was raised considerably by this process, but the floats were made for a larger vessel, and, when inflated, a large portion of them rose above the water. The utility of this apparatus, thus adapting a well-known principle in pneumatics to a practical use, must be obvious to every one.—It enables vessels, with large draughts of water, to pass over barred harbours, as New Orleans, Mobile, Ocracoke Inlet, &c., without lightening. It may be used also with advantage to various other purposes, as raising a vessel sunk in several fathoms of water.

Fig. 1.



THE STEAM ENGINE.



2.

THE STEAM ENGINE.

Of all the machines which human ingenuity has contrived, or human talent improved, the steam engine is the most wonderful, the most perfect, and the most generally applicable to useful purposes; and not to be acquainted with its principal action, and more important parts, implies an ignorance such as no scientific person, whatever may be his peculiar object of study, would or ought to retain. We have already, (in page 225,) given an account of *the boiler*, and its appendages. The following describes *the engine*, or that application of the steam, and beautiful arrangement of chemical and mechanical contrivances by which motion is produced, and which being once attained may be conveyed to any distance, and applied to the moving of an endless variety of machinery.

We shall first give a brief summary of the general course of the steam, and motion of the various parts, and afterwards explain their more particular action. Fig. 1 represents all of the double action engine of Watt, and from the general construction of which most other modern engines are formed, they being, for the most part, but slight modifications, adapted either for locomotion by land or sea, or for particular manufacturing processes. The steam passes from the boiler by the pipe P; it passes through K, where the valves are situated, alternately to the top and bottom of the piston, withinside the cylinder I, which it drives up and down; the steam escapes also alternately into the condenser R, here it is condensed by water from the cock S, and being changed into hot water, it passes through a valve at the bottom to the air pump T; by this pump it is passed to the hot water cistern V, and by the pump there placed, a part of it is conveyed again to the boiler by the pipe U, whence it first came in the shape of steam. The only motion here seen is that of the various pump rods, and that of the piston within the cylinder. Of these motions the latter is the only one produced by the steam itself; all other motions whatever being clogs upon the powerful action going on in the cylinder, and not contributing in any manner to increase that action, except in removing the superfluous steam, when it has accomplished its purpose of propelling the piston up or down. The motion of the piston is of course transferred to the piston-rod connected with it, the upper end of this is connected with a large beam A B, supported by a central axis C, and gradually tapering towards each end—this is called the *working beam*, these parts are connected together by what is called the parallel motion, a contrivance for keeping the piston-rod exactly upright through every part of its course; the same purpose it also accomplishes with the rod of the air pump T. The parallelism of the other pumps V and W is of less consequence, though both it will be seen are worked by the beam A B. The pump W is to supply cold water to the cistern Z, where the condenser and air pump are contained. The end B of the working beam has attached to it a connecting rod X, which by a crank turns the fly-wheel Y, this fly-wheel is intended to equalize and steady the motion of the whole; and let young mechanics always remember, that every machine, whether of a large or small character, all clock-work, automata, &c., moved by any power which gives them their impulse at once, must be terminated by either a fly-wheel or a pendulum, or an equal and steady motion cannot be preserved; for this purpose then, and this only, the fly-wheel is necessary; it adds not one jot to the power of any machine, but is an impediment in proportion to its weight and size, yet it cannot be dispensed with. Its action is as follows:—it first takes to itself a certain quantity of power or motion, and treasures it up, acquiring thereby what is called a *momentum*; when the machine is stopped by any cause, it lets loose this acquired power, and moves the machine a little further, until it can again act. Thus in the steam engine, when the piston J is quite at the top of the cylinder, the steam cannot enter above it, and therefore can move the engine no further, but the great wheel, by its momentum, turns it a trifle, and the steam enters and acts as before. The axis of the wheel is the part connected with the machinery to be moved by the whole engine, and which is no part of it, but the axis also moves the valves by which the supply of steam is regulated, and its course directed alternatively above and below the piston, and into the condenser. The first purpose it accomplishes by means of the *governor* N; the other by the eccentric rod I. The structure of these parts, together with that of the valves themselves, is now to be noticed.

The governor N consists of two heavy balls, connected together with four rods of metal. Two of these rods, those to which the balls appear particularly attached, move up and down on joints at the top of them, under where is seen a pulley with a cord passing over it, and over another pulley to the axis of the fly wheel. The other two rods are fastened at their upper end also by moveable joints to the former, and at the lower end by similar joints to a socket, which slides up and down on the axis that supports the whole. The socket below has fastened to it an iron rod O, extending to a valve in the steam pipe P. This is called the *throttle valve*,* and regulates the quantity of steam passing, as follows:—The great wheel by turning round moves the cord N—this works the governor N. The governor the rod O, and the rod works the valve. Now if the engine goes too fast, (that is, if the wheel goes too fast, for the wheel represents the motion of the whole,) the governor will revolve with proportionate rapidity, and the balls will by centrifugal force fly out, which the various joints of the rod enable them to do. In thus flying out, the socket below, and the end of the rod attached to it, is drawn up. The other end is, in consequence of its turning on an axis, depressed, and shuts more or less the throttle valve, and thereby steam is admitted, and the engine goes slower. its motion be too slow, the contrary takes place, and more steam than ordinary passes into the cylinder.

The above only regulates the quantity of steam, and not the manner of its application. To this end other valves are necessary—these are called the nozzles, the strict use of which is seen better in Fig. 2, which represents the cylinder and pipes that lead into it. O is the cylinder with its piston. S represents the steam pipe. C the condenser. The steam enters at S, and fills the space D from top to bottom. At D is seen a dark line, with a square at the top and bottom of it. This altogether moves up, and down. In the position shown it is drawn up, and it will be seen by the arrow how the steam enters to the top of the piston, and also how the steam may issue round the lower part at N, as the other arrow directs to the condenser through the pipe C. When the rod D with its pieces of metal, and which are called *slide valves* from their sliding

up and down, is drawn downwards to its lowest point, the upper *port-hole* will be opened to the condenser, and the lower one to the admittance of the steam, exactly contrary to the former case: thus the steam enters and departs alternately from each side of the piston, driving it down in one case, and up in the other. The slide valve may be moved either by a rod, which passes through the top of the nozzles to the beam above, or else by the *eccentric motion*. This is represented in I I. One end is seen, (that to the left-hand,) connected with a small arm adjoining the cylinder, and which moves up and down by the valves within. It is itself put in motion by the eccentric rod, moving backwards and forwards, owing to its being attached in a particular manner to the axis of the fly wheel. There is seen in the cut, Fig. 1, on the axis alluded to, a wheel fixed to it eccentrically—that is, out of the centre: the rod which works the valves is fastened to a hoop of metal, fitting easily over the eccentric wheel, and in consequence as the axis turns round, it draws the rod backwards and forwards with an easy and regular motion.

Such is the Steam Engine—that glory to English genius, and that stupendous assistant equally to her manufactures, and to the transit of them over the world. To explain its uses were impossible, so numerous are they; to explain its simple structure we have attempted; to show its perfection of action we shall conclude with an admirable passage from Dr. Arnott's "Elements of Natural Philosophy:"—

"It regulates with perfect accuracy and uniformity the number of its strokes in a given time, and it counts and records them as a clock does the beats of its pendulum; it regulates the quantity of steam admitted to work; the briskness of the fire; the supply of water to the boiler; the supply of coals to the fire; it opens and shuts its valves with mathematical precision as to time and manner; it oils its joints; it takes out any air which may accidentally enter into parts that should be vacuous; it warns its attendants by ringing a bell when any thing goes wrong, which it cannot of itself rectify; and with all these talents and qualities, and though it have the power of 600 horses, it is obedient to the hand of a child; its aliment is coal, wood, charcoal, or other combustible; it consumes none while idle; it never tires and wants no sleep; is not subject to malady when originally well made, and only refuses to work when worn out with age; it is equally active in all climates, and will work at any thing; it is a water pumper, a miner, a sailor, a cotton-spinner, a weaver, a blacksmith, a miller, indeed it is of all occupations; and a small engine in the character of a steam pony may be seen dragging after it on a railroad 90 tons of merchandize, or a regiment of soldiers, with speed greater than that of our fleetest coaches. It is the king of machines, and a permanent realization of the genii of eastern fable, whose supernatural powers were occasionally at the command of man."

BRITISH MARBLES.

(Resumed from page 267, and concluded.)

Scotland abounds in marbles, but only a few of them are generally known. A particularly fine variety of white marble is found in immense beds at Assent in Sutherland, out of which blocks of any size may be cut. The best sort is seen in the bed of the river, about a mile or two south of the church.

A dark brown variety, beautifully variegated with white, is mentioned by Dr. Meck as being found in the parish of Cambuslang, in the county of Lanark. Of this marble, which takes a very good polish, there are several slabs in the palace of Hamilton; a chimney piece in the college library of Glasgow; and three pair of solid jambs in Mr. Dundas's house at Duddinstoun. The stratum which has been hitherto seen, is from six to twelve inches thick, and extends over a considerable part of the parish.

Also, the red and white marble of Boyne; and the white, with long veins of a different tint, from Durness, are mentioned by authors.

An ash grey variety, variegated by beautiful lemon yellow stripes, which traverse it in different directions, and which seem to be owing to an intimate combination of chlorate or hornblende with the marble. A variety of a pure white color, with a slight admixture of blueish grey, in which alone it differs from the fine marble of Carrara.

But one of the most beautiful varieties is that from the hill of Belephetrick, in Tirie one of the Western Islands of Scotland. It is now generally known by the name of Tirie marble; its color is pale blood red, light flesh red, and reddish white; these colors are often seen in one and the same piece; the darker shades generally has spots and waved striæ. What renders this marble particularly curious is the hornblende and the other green substance which it contains disseminated, and part of which appears to belong to that species of the hornblende family which is now generally called sahlite; the lighter colored particles have been considered corundum. It is mixed in different proportions with the marble so as to produce pale blackish green, dark asparagus green, and a color approaching to leek green, also particles of calcareous spar are seen intermixed with this substance as also small rounded quartzy particles of a bright red color, and some mica in plates; some of its varieties have the appearance of granite.

Besides this, Professor Jameson mentions a white marble of the same kind, found with the one just mentioned; its color is white or very light blue; it contains scales of mica, and crystals of hornblende, which latter, when minutely diffused, give the marble a green or yellowish green color, and when intimately combined with the mass, form beautiful yellowish green spots.

A dark colored shell marble occurs in the limestone quarries of the parish of Cummertrees, in the county of Dumfries, and large blocks of it have been worked up for chimnies and hearths, some of which have been sent to London. The shells, and other petrified bodies with which it is mixed, greatly add to its variety and beauty, as the whole receives a very fine polish.

Ireland also has its valuable marbles, and quarries of them are wrought in various parts.

The variety best known in England is the Kilkenny marble, with black ground, more or less varied with white marks produced by petrifactions. This marble, contains a great variety of impressions of madrepores of bivalve and turbinate shells; mytilites, turbinites, pechinites, tellinites, tubiporites, nautilites, and ammonites may be distinguished. The spar which occupies the place of the shells, sometimes assumes a greenish yellow color; in some places there are spots, though rarely, that

reflect iridescent colors, and sometimes martial pyrites is imbedded in the marble. A kind of flaw sometimes appears in the stone, which from its irregularly indented figure is styled by the workmen a skull, as it resembles the sutures of a cranium.

The half-moon and the bottom bed are reckoned among the best: the former is so called from the number of impressions of bivalve shells which it contains; the sections of the spaces they occupied, now filled with white spars, being more or less lunated; the black bed and the silver bed are both esteemed. The marble which approches nearest to black is most valued at Kilkenny. The white marks on the polished stone, it is said, appear more strongly, or increase, by long exposure to air.

Some coarse work of Kilkenny marble is finished at the quarry; a few of the blocks are split in the town by hand saws, where a little of the polished work is also done, and tomb-stones are cut, which are raised from a different quarry.* But the principal work is done at the marble mill, which is on the left bank of the river, near two miles from Kilkenny.

Black marble exceedingly fine has been raised at Crayleath, in the county of Down. It is susceptible of a very high polish, and if well chosen is free from those large white spots which are supposed to disfigure some of the Kilkenny marble.—*Dubourdieu's Survey.*

In the country of Waterford different kinds of marble are discovered, as at Toreen, a fine variegated sort, composed of chocolate color, white, yellow and blue, blended into various shades and figures, which takes a good polish. A black marble, without any mixture of white, has been found near Kilcrump, in the parish of Whitechurch, of the same county, as also a grey marble beautifully clouded with white, spotted like some kinds of shagreen, and susceptible of a high degree of polish.

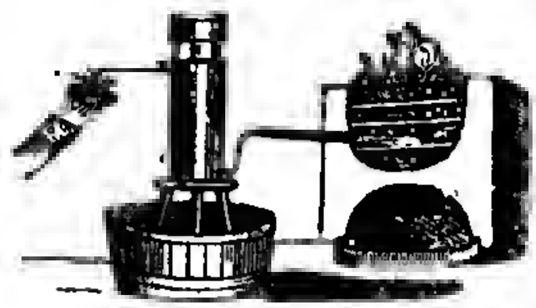
OXYGEN.

ITS PROPERTIES AND PREPARATION.

OXYGEN was discovered by Dr. Priestley, in 1744. It is a colorless gas, has neither taste nor smell, is not affected by light or heat, is rather heavier than atmospheric air, its specific gravity being 1.111—is very sparingly absorbed by water, possesses neither alkaline nor acid properties, and combines with all the other simple bodies, producing with some of them acids—with others oxydes. It is one of the constituent principles of air and of water—is the most perfect of all supporters of combustion, and is absolutely necessary for animal existence. The atmosphere being adapted to support combustion and animal respiration, only in proportion to the quantity of oxygen it contains. By the absorption of this gas the venous blood when passing through the lungs become purified from carbon, and restored to the bright red color which arterial blood presents. Its influence upon colors is often very great, and is taken advantage of by dyers. Oxygen is given off naturally by growing vegetables, and may easily be procured artificially by abstracting it from the metallic oxydes, or the salts which contain it, and also by the decomposition of water by galvanism.

Experiment 1.—*From Vegetables.* Put into a wide-mouthed bottle a quantity of fresh gathered leaves—fill the bottle with water, and turn the mouth downwards. Place this in a hot sunshine, and after some hours the upper part of the glass bottle will be filled with gas, which by a proper test will be found to be oxygen.

Ex. 2.—*From Black Oxyde of Manganese alone.* Put into a gun barrel, which has previously had its touch-hole stopped up, eight ounces of the black oxyde of manganese in powder. Place it in the fire and when approaching a red heat oxygen gas will begin to pass out at the open end, as may be known by the increased flame of a candle held to it. When this is the case, fasten a collapsed bladder to the open end of the barrel, so as to be air-tight, when the gas will pass into it, and may be preserved for use. This quantity of oxyde should make about two gallons and a half of gas: it is not perfectly pure, but sufficiently so for ordinary experiments. Instead of the bladder a pewter tube may convey the liberated gas either to a gas-holder, or to glass receivers, placed upon the shelf of the pneumatic trough for its reception.



Ex. 3.—*From Oxyde of Manganese and Sulphuric Acid.* Place in a glass retort four ounces of the black oxyde of manganese, and add to it strong sulphuric acid, sufficient to make it of the consistence of cream. Apply the heat of an Argand lamp, and the gas will pass over when the liquid boils. This is only useful when a retort is not at hand, being a more expensive mode than the last, especially as the retort is apt to be cracked by the caking together of the materials.

Ex. 4.—*From Chlorate of Potass.*—Put into a glass retort a quarter of an ounce of the chlorate of potass. Place a lamp under it, and when it arrives at nearly a red heat it is wholly resolved into very pure oxygen gas, which may be collected in the usual way: and a white powder, called chlorida of potassium, which is left in the retort. The above quantity of salt yields rather more than half a gallon of gas, or about one entire inch of gas for each grain of the salt.

Ex. 5.—*Combustion of a Taper.*—If a lighted taper be immersed in a jar of oxygen gas it will burn with much more than ordinary vividness and rapidity; and if the taper be extinguished, but so as to leave the wick still kindled, and then immersed, it will instantly become inflamed. This may be performed several times with the same jar of oxygen.

Note.—A modification of this experiment forms the celebrated *Bude Light*, which is nothing more than a stream of oxygen passing through a burning lamp, the brilliancy of which is thereby greatly increased.

Ex. 6.—*Brilliant Red Fire.*—Dissolve in spirits of wine as much as it will take up of the nitrate of strontian—light the spirit, which will burn with a faint red light. Immerse it while burning in a jar of oxygen gas, and the brilliancy of the flame will be very greatly increased, and appear of the most vivid red. If a few crystals of nitrate of strontian be placed upon the charcoal, it will burn with intense vividness, when a jet of oxygen is projected upon it. The

will be the case with the substances in the following illustrations:—

Ex. 7.—*Rose Colored Flame.*—Dissolve chloride of lime in spirits of wine, inflame it in oxygen, and it will burst into a larger and stronger flame of a dull red light.

Ex. 8.—*Green Light.*—Instead of chlorate of lime use a few crystals of boracic acid, stir it well to dissolve the acid, and after inflammation and immersion in the oxygen, a bright and beautiful green flame will be produced. The same will take place if the nitrate of copper be used.

Ex. 9.—*Yellow Flame.*—Dissolve carbonate of barytes in spirits of wine, inflame it under the same circumstances, and the flame will be yellow. The same will be the case if the chlorate of soda or common salt be used.

Ex. 10.—*A Reddish Yellow Flame* is produced by burning in the same way chlorate of magnesia.

Ex. 11.—*Amber Colored Light.*—May be produced with much intensity by burning a piece of amber in oxygen gas.

Ex. 12.—*White Light.*—Many substances burnt in oxygen will produce a white light, as phosphorus, caoutchouc or Indian rubber, most of the resins, &c. That, however, which produces the clearest and most brilliant white, next to phosphorus, is a small piece of camphor suspended from a wire in a jar of the gas.

Ex. 13.—*Re-kindles a nearly-extinguished Fire.* Project a stream of oxygen upon the smouldering embers of a fire nearly extinguished, it will immediately lighten it up afresh, showing that combustion is in exact proportion to the quantity of oxygen communicated to the combustible body; a piece of saltpetre thrown into a fire answers the same purpose, because of the oxygen it gives out in burning.

Ex. 14.—*Ignition of Charcoal.*—Fasten to a wire a piece of charcoal, tying it with another bit of wire, hold it to a candle so as to ignite it in one speck only, immerse it in a jar of oxygen, and it will burn with the utmost beauty, forming by the chemical action which takes place, carbonic acid gas; the oxygen uniting with the charcoal. For this experiment, the charcoal should be near the bark of the tree, and of some light wood, as then brilliant sparks are thrown off.

Ex. 15.—*Combustion of the Diamond.*—The combustibility of the diamond seems first to have occurred to Newton. The burning of it by artificial means is thus described by Brande:—" When the diamond is heated in the flame of the blow-pipe it soon begins to burn, and the combustion continues as long as the temperature is sufficiently high, but it does not produce heat enough, during its combination with the oxygen of the atmosphere, to maintain its combustion. If while thus burning, it be introduced into a jar of pure oxygen, the combustion continues longer, and sometimes till the whole is consumed: the best support for it in this experiment, is a small loop of platinum wire, or a very small and thin platinum spoon, perforated with many holes; in this it may first be intensely heated by the oxygen blow-pipe, and whilst burning, carefully immersed into a bottle of pure oxygen gas, containing a little lime water; a good cork through which the wire of the spoon passes should secure the mouth of the bottle; it will thus go on burning brillantly for some time, and the formation of carbonic acid be shown by the milkiness of the lime water.

" The combustion of the diamond may be more perfected, by placing it upon a platinum capsula, in a jar of pure oxygen inverted over mercury, and throwing upon it the focus of a burning lens. It will continue to burn in the oxygen after being withdrawn from the focus with so brilliant a light as to be visible in the brightest sunshine, and with very intence heat."—*Brande's Chemistry.*

Ex. 16.—*Combustion of Sulphur.*—Place in the platina or brass spoon, a small piece of sulphur, previously inflamed; immerse it in a jar of oxygen, and the combustion will be greatly increased in brilliancy, the whole jar showing the most vivid blue light. When the combustion is finished, the jar will contain sulphuric acid, which at first rises as a brown vapour, and is rapidly absorbed by the water.

(Continued on page 299.)

OIL PAINTING.

(Resumed from page 266.)

The various bodies employed by painters for producing the difference of light and shade may be termed either pigments or fluids, as they are solid or aqueous, but their varieties are too numerous to be in general use; most painters therefore select a set out of them, and become very unjustly prejudiced against those they reject. Those colors which become transparent in oil, such as lake, Prussian blue, and brown pink, are frequently used without the admixture of white or any other opaque pigment, by which meanes the tint of the ground on which they are laid retains, in some degree, its force, and the real color produced in painting is the combined effect of both: this is called *glazing.*

PRINCIPAL COLORS.

Flake White, or *Fine White. Krem's White.* Flake white is the best we have; it ought to be ground with the finest poppy oil that can be procured. White comes forward to the eye with yellows and reds, but retires with blues and greens. *It is the nature of all whites to sink into whatever ground they are laid, on which account they ought to be laid on white grounds.

Ivory Black is an exceeding fine color, which mixes well with the others, and is the true shade for blue. It is used with drying oil, and is a cold retiring color.

Ultramarine is the finest blue known; it is a tender retiring color, well adapted for glazing. It is used with poppy oil.

Prussian Blue is a very fine blue, and is used with nut oil. It should never be used in the flesh, but in green tints and the eyes.

Light Ochre is of great service in painting flesh, it is used with nut oil. All yellows are strengthened with reds and weakened by blues and greens.

Light Red (Light Ochre burnt), mixed with white, produces a most perfect flesh color, but is too strong for the white, therefore will get darker. It should be used with nut oil.

Vermillion should never be used unless it is made of genuine native cinnabar; it is used with drying oil.

Lake is a deep red, but of no strong body, and should be strengthened with Indian red. It is the best glazing color that can be employed; and is used with drying oil.

Indian Red will not glaze well; it is used as the lake.

Brown Pink is a fine glazing color, but of no strong body. In the flesh it ought not to join or mix with the whites, as it produces a dirty warm color, for which reason their joinings should be blended with a cold middle tint. In glazing of shadows it should be laid before the other colors that are to enrich it. As it is one of the finishing colors it should never be employed in the first painting. Used with drying oil.

Burnt Umber is a good warm brown of great use in painting the hair, and mixes finely with the warm shade.

PRINCIPAL TINTS COMPOSED FROM THE FOREGOING COLORS NECESSARY FOR PAINTING FLESH.

Light Red Tint is made of light red and white; with this color and the shade tint you should make out all the flesh; as this color gets darker, you should mix vermillion and white with it, according to the fairness of the complexion.

Vermillion Tint is vermillion and white, mixed to a middle tint, which is the brightest light red that can be made.

Carmine Tint is carmine and white. This is the most beautiful of all reds for the cheeks and lips. It is one of the finishing colors, and not to be used in the first painting, but laid on the finishing colors without mixing with them.

Rose Tint is a compound of white and the red shade, and is one of the cleanest and most delicate tints that can be used in the flesh for clearing up the heavy dirty colors.

Yellow Tint is formed of various substances, sometimes of Naples yellow and white, and also of chrome yellow and white; and light ochre and white, which is a good working color.

Blue Tint is composed of ultramarine and white, and is of great service in blending and softening down the lights to produce *keeping*.

Lead Tint is ivory black and white.

Green Tint consists of Prussian blue, light ochre, and white. It is generally used in the red shadows when they are too strong.

Shade Tint is lake, Indian red, black, and white, mixed to a middle tint. This is the best mixture for the general ground of shadow.

Red Shade is made of lake and a very small portion of Indian red: it strengthens the shadows of the shade tint, and is often used as ground for dark shadows.

Dark Shade is made of ivory black and a little Indian red. It is excellent for glazing the eyebrows and the darkest shadows.

These directions, well understood, will enable the student to form any other tint he may require. He must always remember that white mixed with any color, or with any composition of colors, always makes them lighter; but if any color or tint be too light it can never be rendered deeper by the addition of black, and the best way to deepen a color is by glazing it over with a darker color of a similar nature. Glazing should always, if possible, be performed with transparent colors. It is, however, a practice not universally adopted, and seldom performed by artists whose skill enables them to produce an equal effect without it.

The oils with which the colors are mixed are of more importance in the art than is generally imagined. Those in most use are linseed oil, nut oil, and poppy oil. Linseed oil injures light colors; its use is therefore generally confined to the darker ones. Nut oil is in more habitual use, is of a finer quality, and is not so subject to change the colors. Poppy oil is generally preferred to the two others, it is clearer than the nut oil. For pictures painted in haste drying oil is sometimes used, it should, however, be employed with great caution, as the paintings in which it has been too extensively used are found in a short time to have the appearance of being old and decayed.

(Continued on page 316.)

PRESERVING FUNGI.

(Resumed from page 285, and concluded.)

The Laplanders employ *Polyhorus fomentarius* and some other species, (which when beaten and steeped in saltpetre form most excellent tinder, known by the name of *Amodou,)* to remove pain by simply laying a small piece upon the part affected and igniting it. It is said that this remedy seldom fails. *Amodou* is also sometimes used like the soft contents of *puffballs* as a styptic, and forms occasionally a material for paper-making. When used, however, for stopping blood, it must be free from saltpetre.

In the economy of the world, *Fungi* performs a most important office in hastening the decomposition of dead organized matter. It is this property which renders one or two species, known under the common name of *dry rot*, such a dreadful plague in ships and buildings. The disease doubtless originates on some unsound portion of the wood, but, once established, it spreads with wonderful rapidity, and decomposes the sound wood beneath it, by absorbing its nutritive matter. The remedy is not difficult, where its practicability to guard against the concurrence of circumstances favorable to its progress; but in many instances this is impossible. Various schemes have been proposed for its general prevention, but unsuccessfully, until Mr. Kyan impregnated the wood with corrosive sublimate, a well-known enemy to vegetable life, which by combining with the nutritive matter of the wood renders it unfit for the support of vegetation, and as far as such short experience can testify, completely proved its efficacy. White of egg might probably be used with advantage on a small scale, as it seems equally with corrosive sublimate, to prevent the growth of fungi; indeed it is sometimes employed by house-keepers for the prevention of mould by simply covering the article to be preserved with paper steeped in it. In herbaria and cabinets, mouldiness must be kept away by the use of essential oils, or Russia leather.

Fungi are very destructive to corn, in the form of *Blight*, *Mildew*, *Bunt*, &c., doing injury not only by a diminution of the quantity but also of the nutritive matter, and as in the case of bunt, by communicating to the corn an offensive taste and smell.

The growth of these parisites depends so much upon accidental circumstances, that it is impossible for the most experienced cultivators to guard against them altogether, but the evil is greatly lessened by careful choice of seed, by steeping it in solutions of different substances, which destroy the vegetative power of the *sporidia* of these parisites, and by a judicious change of cropping, in the land subject to them. It appears that the reproductive contents of the sporidia are absorbed together with the water, containing the nutritive matter of the soil by the roots. At least it is certain that corn, sown in soil, which has been purposely mixed with the sporidia, is infested with the fungi to which those sporidia belong; and this has been proved also with regard to one of the entophytal parasites to which roses are subject. Most plants are preyed upon by their peculiar parisites; pear-tree, for instance, are sometimes much injured by *Æcidium cancellatum*, and young trees planted in their neighbourhood are observed to suffer.

The roots of certain plants, as, *Saffron-Crocus*, *Lucerne*, *Convulvulus*, *Batatus*, &c., are frequently exhausted by subterranean fungi. In the case of saffron, the only remedy is to insulate the infected plot by a deep trench, which should seem to be a striking proof that these plants are really increased by seed.

Dr. Klotzsch writes thus:—" The method I adopt by which the *Agorics* and *Boleti* may have their characters preserved and be fit for examination in the herbarium, is as follows:—

" With a delicate scymetar-shaped knife, or scalpel, such as is found in a surgeon's instrument case, I make a double section, through the middle, from the top of the pileus to the base of the stipes, so as to remove a slice. This, it will be at once seen, shows the vertical outline of the whole *Fungus*, the internal nature of its stipes, whether hollow, or spongy, or solid; the thickness of the pileus and the peculiarities of the gills, whether equal or unequal in length, decurrent upon the stipes or otherwise, &c. There will then remain the two sides or (nearly) half the *Fungus*, which each in itself gives a correct idea, if I may so express myself, of the whole circumference of the plant. But before we proceed to dry *them*, it is necessary to separate the stipes from the pileus, and from the latter to scrape out the fleshy *lamellæ*, or *gills*, if it be an *Agoric*, or the *tubes* of the *Boletus*. We have thus the fungus divided into five portions; a central thin slice, two (nearly) halves of the stipes and the same sections of the pileus:—these, after being a little exposed to the air that they may part with some of their moisture, but not so long that they shrivel, are to be placed between dry blotting paper and subjected to pressure as other plants: the paper being changed daily till the specimens are perfectly dry. When this is the case, the central portion or slice, and the two halves of the stipes, are to be fastened upon white paper, together with the respective halves of the pileus upon the top of the latter, in their original position. He will thus be three sections, from which a correct idea of the whole plant may be obtained. The *volva* and *annula* of such species as possess them, must be retained.

" With care, even the most fugacious species, such as *Agaricus fimelarius*, *ovatus*, &c., may be very well preserved, according to this method.

" Some of the smaller and less fleshy kinds will not require to have their lamellæ removed, such as *Agaricus filopes*, *epipinus*, *galericulatus*, &c. In collecting fleshy *Fungi*, care must be taken that they are not too old and absolutely in a state of decomposition, or too much infested with the larvæ of insects. When this latter is the case, some oil of turpentine poured over them will either drive them rapidly from their holes or destroy them. Species, with a clammy viscid pileus, it is better to expose to a dry air or the heat of a fire, before being placed in paper.

" The separate parts of the genera *Phallus* and *Clathrus*, I fill with cotton. I keep them for a time exposed to a dry atmosphere, and then after removing the cotton, subject them to pressure. The same may be done with the large tremelloid *Prezizæ*."

To this Dr. Hooker adds:—" I have witnessed, with great satisfaction, the whole of the above process for drying the fleshy *Fungi*, and have now many specimens in my herbarium preserved according to this method. Not only is the outline of the *Fungus* thus retained, and in most instances, its essential distinguishing character; but there is this further advantage, that from the specimens containing a smaller quantity of fleshy matter, they are infinitely less liable to the depredations of insects than if the whole *Fungus* were submitted to pressure. In order to protect my herbarium in general, as much as possible from these troublesome visiters, I wash (with a camel-hair pencil) or sprinkle, such specimens as are most subject to them, with oil of turpentine, in which I put a small quantity of finely pounded corrosive sublimate. It is true that this substance is not dissolved in the oil; but by shaking the bottle before using it, it is widely spread over the specimen so treated, and remains to protect the plant after the oil has evaporated. Spirit of wine extracts the color from the plant, and soils the paper on which the latter is fastened, as I have ascertained by experience."

CHEESE CEMENT FOR WOOD, CHINA, &c.

COMMON glue is well known to be soluble in water, and that after any length of time has elapsed since its first application, those articles, therefore, which are glued together are only such as are ordinarily to be kept dry, lest the moisture to which they may be exposed should dissolve the glue which unites their various joints, and they fall to pieces. The only prevention of this effect has hitherto been paint or varnish to keep off the wet. There are, however, very many cases in which glue would be used were it not for this solubility, such, for example, as vessels to hold water, hot or cold; furniture for sea use, where they may be exposed to a damp atmosphere; show-boards for houses; external shutters and doors, and numerous other cases. It is somewhat surprising, therefore, that no attempt should have been made in this country to introduce to general use the famed *cheese glue*, which is employed on the continent under most of the above circumstances and with complete success. It is known, indeed, as a cement for joining china and glass, and believe it is the same as Vancouver's cement, sold at a great price for that purpose. It is certain, at least, that such articles may be joined together with it, so as to have a neat joint, and to resist equally the unequal degrees of temperature to which such articles are exposed, and also water and acids. It may be useful then in joining broken galvanic troughs, &c. Applied to wood it is extremely tenacious, and equally resisting. The

following is the receipt:—Take some fresh cheese made with rich creamy milk, (Cheshire cheese will do,) pound it, and wash it in warm water until all the soluble part is carried off by the water—this may be operated in a sieve, or linen cloth, through which the cheese is afterwards pressed to get rid of the water; when quite drained, it crumbles like stale bread: it is then dried upon unsized paper, and in that state will keep fresh a very long time.

This material, which is *caseum*, mixed with a small proportion of butter, is not soluble in water, except by the addition of quick-lime; but by pounding this with the mixture it becomes transformed into a very viscous sort of cheese, which can be diluted with water to the consistency required for the work. *It dries quickly, and when quite dry it cannot again be dissolved*, therefore no more should be prepared than can be immediately used. This is one of the causes why it has been so little used; but at all events, a solid advantage is worth the trouble and difficulty of its preparation and use, besides these difficulties would be greatly diminished by keeping in a well-closed vessel some powdered quick-lime, to mix with the caseum, at the time of pounding. It would be still better to soften the caseum in hot water, and for expedition sake the two substances should be kept in a close vessel, being previously mixed dry and reduced to a fine powder. It is applied in the same manner as common glue.

The above receipt was known to the ancients, even it is supposed in the time of the Greeks, and in the flourishing age of the Italian school of painting, commonly employed to join together the various parts of their panel boards.

THE MOLE.

It is remarkable that this animal sometimes gives notice of a change of weather. The temperature or dryness of the air governs its motions as to the depth at which it lives or works. This is partly from its inability to bear cold or thirst, but chiefly from the necessity it is under of following its natural food, the earthworm, which always descends as the cold or drought increases. In frosty weather, both worms and moles are deeper in the ground than at other times, and both seem to be sensible of an approaching change to warmer weather before there are any perceptible signs of it in the atmosphere. When it is observed, therefore, that moles are casting hills through openings in the frozen turf, or through a thin covering of snow, a change to open weather may be shortly expected.

The cause of this appears to be as follows:—The natural heat of the earth being for a time pent in by the frozen surface, accumulates below it; first incites to action the animals, thaws the frozen surface, and at length escapes into the air, which it warms and softens; and if not counterbalanced by a greater degree of cold in the atmosphere, brings about a change. Changes from frosty to mild weather, caused by the ascent of heat from the earth are often so evident, that the circumstance needs no confirmation. Stronger proof, if proof were necessary, cannot be given than the common appearance of frost or snow remaining longer upon ground having a stratum of rock beneath, than upon that where there is none. Old foundations of buildings, which have not been dug out, are easily traced by the same appearance; and any subterraneous solid body, as large stones, drains, planks, or pieces of timber, may be discovered in the same way; and even a plank laid across a ditch at such times will remain covered with snow for many hours after the snow on the ground is all melted and gone. This sufficiently accounts for the activity of the mole before a change of weather, and deserves to be noted by the meteorologist among his other prognostics of the weather.

The mole, though generally a despised and persecuted animal, is nevertheless useful in some degree to the husbandman, in being the natural drainer of his land, and destroyer of worms. To other inferior animals he is a sapper and miner, forming for them their safe retreats and well-secured dormitories.—*Magazine of Natural History.*

MISCELLANIES.

Varnish for Boots and Shoes.—First Receipt. Taken from "Walton's Angler"—Take a pint of linseed oil with half a pound of mutton suet, the same quantity of bees' wax, and a small piece of rosin. Boil all this in a pipkin together, and use it when milk-warm with a hair brush: two applications will make the articles waterproof.

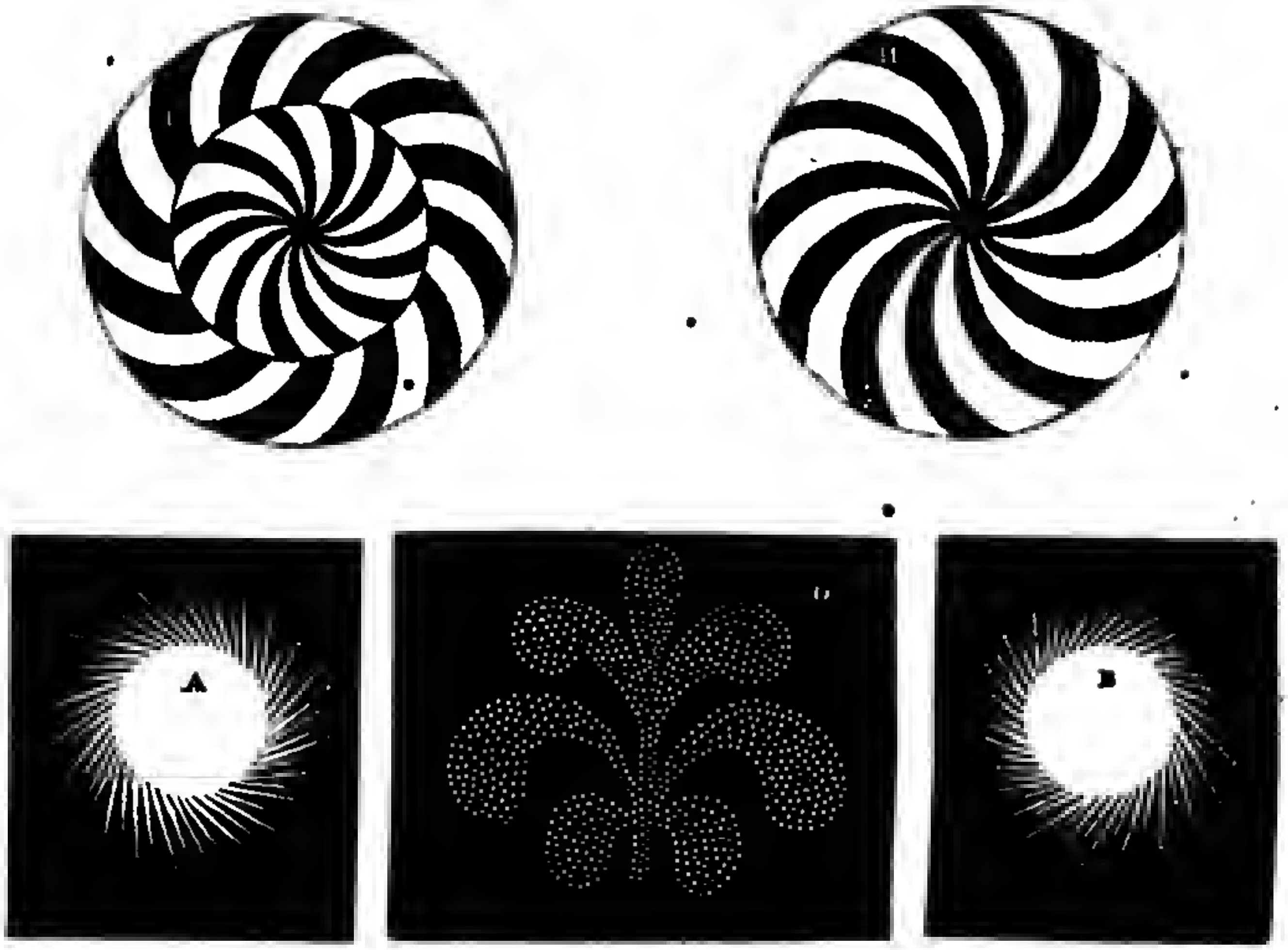
Second Receipt.—Common tar is to be made warm, and brushed over the soles of boots or shoes; these are to be put near the fire, that the tar may be absorbed. When this is the case, a second, and afterwards a third, may be used with advantage. This is not applicable to the upper leathers, though it makes the soles very much more durable, and impervious to moisture.

Third Receipt.—India-rubber varnish is a valuable article wherewith to anoint the upper leather of boots and shoes; it covers them, however, merely with a resisting varnish, but the lower parts subject to abrasion from contact with the ground are little benefitted by its application.

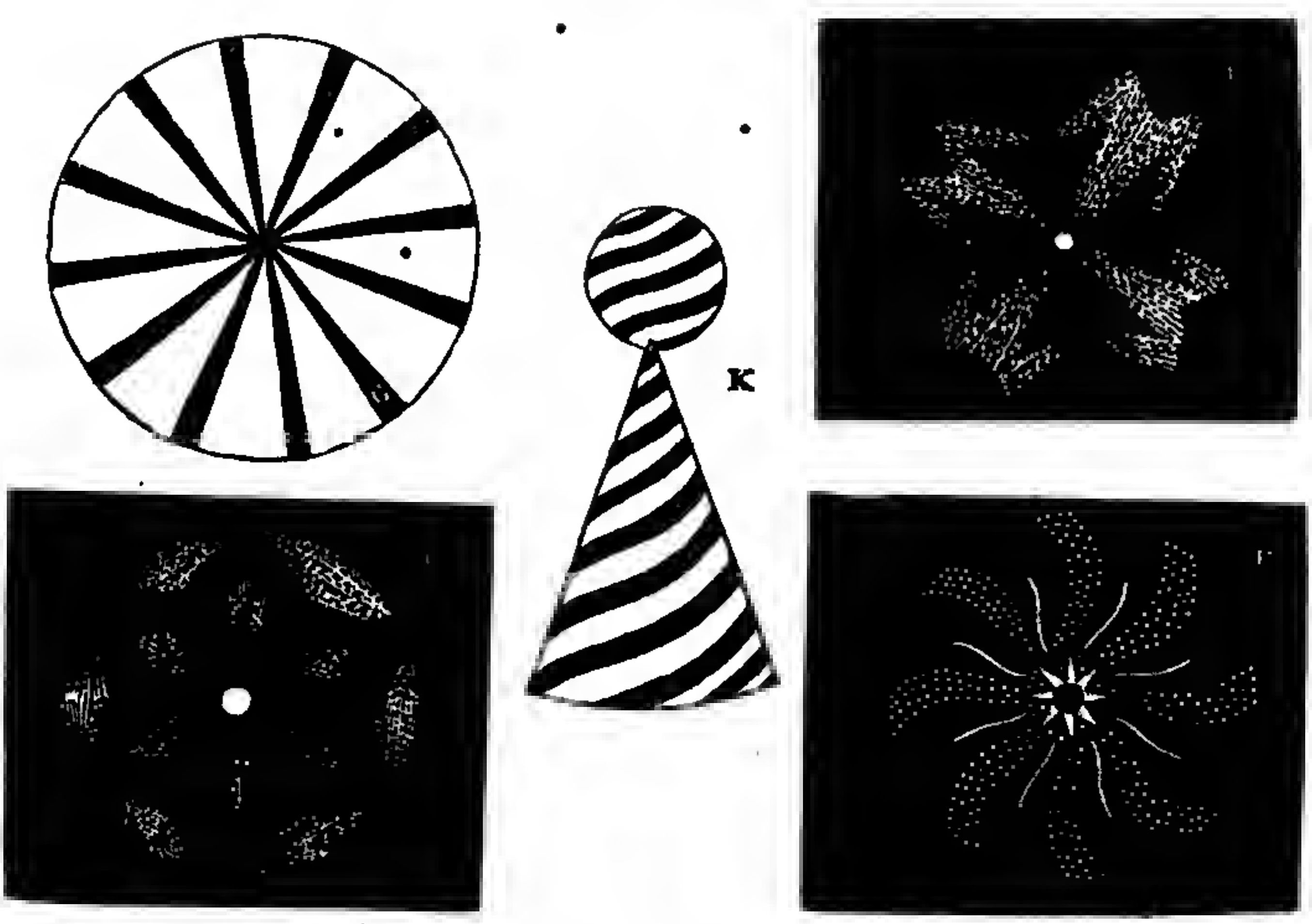
The Blast in Iron Smelting Furnaces was originally produced by means of bellows; and so strong was the prejudice in favor of this method, that when the iron cylinders were first proposed it was with the greatest difficulty they obtained a trial;—nor was it till after the lapse of several years that the "stubborn fact" of their producing twice the quantity of iron which had been ever reached by the old bellows, led to their universal adoption. The Tintern Abbey Works were the first at which cylinders were employed. The density of the blast furnished by the bellows rarely exceeded one pound on the square inch, but the increase through the employment of the cylinders is, in some instances, four-fold, and on the average more than double.

For Mildew on Trees.—To 4 gallons of rain or river water add 2lbs. soft soap, 1 lb. flowers of sulphur, 1 lb. roll tobacco, 1 quart fresh slacked lime, and 1 pint of spirits of turpentine. Mix the whole well together, and boil the mixture slowly for half-an-hour.

A perfect Solvent of Caoutchouc.—Take equal weights of sulphuric acid and water, mix them, and when cold add a quantity of it to a quantity of oil of turpentine, and agitate thoroughly; the acid will become colored by uniting with, or charring the resin; let the acid subside, and decant the clear spirits. Repeat the operation until the acid subsides without being discolored. The oil of turpentine thus prepared, with warmth, and strong solar light, is a perfect solvent of caoutchouc.



CHINESE, OR ARTIFICIAL FIRE-WORKS.



CHINESE, OR ARTIFICIAL FIRE-WORKS.

Many of our readers no doubt witoessed an exhibition so called at the Colosseum some time heck, and also, perhaps, may have seen the same at Leicester Square some years previously—this it is our present object to describe aod explain. To auch as hava never viewed these imitation works, it may be necessary to remark, thet the room is in darkness, sava such light as comes to it through various transperenciea, &c., which are so cut out as to represent such objects as are usually produced by real fire-works, and by bidden machinery, the whole appears to be in motion, exactly the same as if made of gunpowder, thoogh without its cost, smell, and danger. The following are plain directions to form and manage them :—

First, procure a frame, three or four feet square, and twelve or fourteen inches deep. Stand this upright, and place along its sides three or four lamps or candles; place also a ledge or groove io the front and ona at bottom to slide a pictnre in. This is to hold such pictures as Figs. A B C D E, &c., afterwards to be described, eod plece two wires across it, with a loop in the middle of each, to bear an axle or spindla, which mey be made also of a bit of thick wire. One end of this splodle, that at the back, is to heve n hendle; tha front end of it is to bear tha wheels G H or I, and which wheels when in motioo mnst turn clnsa to the front of the box, aa close indeed as possible. This spindla also oo the front and may heve fastened to it a wheel, of two feet diameter, made of a thin hoop outside, and four or six wire spokes. If this is made properly, when the handle is turned round, the spindle nnd wheel will turn with it, and if a person were to atand in front of it, ha wonld not be able to see the candles through the wheel itself, but only in the space around it; so that if a frame or pictnre be slid into the groove made for it, and that frama be made quite black, except a round hole eqoal in diameter to the wheel, oothing whatever of the lights will ba visible, but tha glare of them. This will render plain what is to follow :—

Consider what deslgns yon will heve, nnd make as many atretching frames (like those for pictnres,) as there are to be figures. Stretch opoo them calico, paper, or parchment, and paiot them on both sides black, with oil paiot or else lamp black, water, end size. When dry, ponch oot opon them the proposed design, taking care, that If it is one which is to appear in motion, the centre must coincide with the end of the spindle, (an inch or two is of little consequence.) We will snppose that in this maoner you hava prepared the Figs. C D E and F. Placing either of tham In its proper place io front of the lights, of course the illaminated part will be colncideot with the figure cut out, and all else ba lo darkness. The exhibition of any number of such would soon become monotonous, without variation of color and of motion; these improvements are easily managed. Paste oo tha prepared design a sheet of tissue paper, and color the spots where it appears with carmine, Prussian blue, verdigris green, or any dye color, which will accomplish all that can be desired oo this head. If you desire it to be extremely brilliant, varnish the colored paper over afterwards, or else mix the color with varnish at first.

To produce the effects of motion is tha object of the wire wheel within the box. To turn it by itself alooe gives some little twinkling, but to produce the qoivering light, oecessary to make the front objects seem in motion, aod casting out sperks of fire, other wheels are necessary. See Figs. G H I. These motion wheels are mede of paper or parchment, exactly as explained io the object framas, except that the holes as represented in the figuras are cut out like spokes, with a penknife, and they ara fastaned each to a hoop, which fits tightly upon the hoop of the wira wheel, so that when that turns, the one fixed to it turns also. Now we will see tha effect of a variety of design hera also. Snpposing the wheel G be fixed in its place, and the design E be in front of it, if tha wheel be turned round, tha only effect will be that E will glitter, and have a quivering appearaoce, but no motion on its centre. When therefore G is used, only anch object as D should be put before it, either white or eolored. This forms e first variety.

Instead of G, place the wheel H, and the object E as before. When tha wheel is turned, the object will seem to revolve also io the seme direction, end also sparks will appear to fly from the centra to tha circumference. This wheel then is adapted to such objects as have e single uniform motion ooly, which forms the second veriety. Such is object D.

A fourth variety is formed by a wheel, eot out as represented in I. In this case the object put in front will seem to have two motions; one from the ceotre, the other away from it. according as it may reach to tha inner or onter circle. Of thia description is design F.

The wheels should not be turned too qoickly, or a mistiness will occur, rather than tha twinkling light reqnired; also the holes punched out ahould be of various sizes, and closer together towards tha centre of motion than at the more distant parts. A *fiery rain* may easily be contrived by having a roller at tha top of the box, and another below—npon which is wound a long coil of black paper, punched full and irregularly with small holes. This beiog pulled down, by turning the lower roller, as tha holes are in motion, and pervious to light, the effect will be like that of a shower of fire. If the sama roll of paper be passed upwards, it will appear like a fountain of fire, especially if an object, made upon the principla of Fig. D, be placed either before or behind it.

The *snow storm*, as represented by the magic lanthorn in Mr. Childe's exhibitioo, is conducted upon this principla; it being caused by a black slider, specked with holes through tha varnish, being drawn *up*, when the white specks, suffering tha light to pass through, look lika flakes of snow falling *down*. Indeed the whole of the above may be easily edapted to tbe magic lanthorn, by haviog a wooden slider, with a brass wheel of reqoisite shape, on ooe side, to be tnrned by e thread around its edga, aod fixed by a screw in the middle. Tha other side of the slider may have a shifting glass, of varied design and color. It should be observed, however, that the light thrown by a magic laothorn is seldom strong eoough to show them with sofficient vividness. If it be desired to have the appearaoce of a cone or globe in motion, cut them out, as lo Fig. K. We have purposely varied the manner of catting oot the objects on C D E and F, but other methods and designs will readily suggest thamselves.

Tha ooly epplication of the ebove which we ara acquaioted with is by Mr. Wallis, the lecturer, in that part of his apperetus represeting the sun.

Every person who has seen it at all must have been delighted with its extreme brilliancy and perfection of motion—seeming to dart out rays from its disk on all sides simultaneously—so good indeed, that a gentleman once remarked to us, at the London Institution, "Mr. Wallis's sun is so excellent it *quite warms the theatre*." The way it is managed is as follows—not regarding the manner of lighting, nor means of motion, which we shall have a future opportunity of doing when treating of astronomical apparatus:—we need only now observe, that the peculiar effect of its rays is occasioned by there being two wheels in front of the lamp, made of white silk, and painted with black, so that the light can pass only as represented on Figures A and B. When these wheels are made to revolve in different directions, the rays will not seem to turn either to the right or left, but like rays from the centre outwards. The explanation of the apparent motion of the rays is easy. One wheel, from what we have already seen, would make the rays of light seem to move one way; the other wheel causes them to move in the contrary direction. Now, as it is impossible that our eyes can witness the double and contrary motion, we view only that compounded of the two, which is, of course, rectilineer.

LIFE OF A PLANT.

The ripe seed, when put into the ground at the proper season of the year, after soaking up the moisture around it, throws downwards a *radicle*, or young root; then there rises upwards the *plumule*, or future stem, bearing upon it the two lobes of the seed. These expand, become green, and furnish the plant with nourishment, till the roots increase, and it gets young leaves of its own. The stem shoots upwards, and is furnished with buds, which throwing out leaves and branches, the whole becomes a perfect plant, capable of fixing itself, and taking up moisture by its roots, growing towards the light by its stem, and decomposing the air around it by its leaves. The various organs it now has conspire to produce flowers—these expand, delighting us by their fragrance and their beauty. The stamens become ripe—their anthers burst, and scatter the pollen with which they are stored; this is taken up by the stigma, and conveyed to the young seeds, which are thereby endowed with the power of growth. The parts of the flower, being no longer useful, fall away, while the seed increases in size and perfection, until at last, when thoroughly ripe, the parent plant either dies, or becomes dormant, until the warmth of a future season again calls it into a vigorous and renewed existence.

During the progress of these various developments many curious phenomena present themselves to our notice. The sap, or moisture, passes upwards and downwards through the veins, or sap-vessels; it is exposed to the air at the leaves and flowers; and it deposits in its course wood, resins, gums, starch, sugar, and numerous other products. One part becomes green, another pink, a third white, yellow, or brown; one yields a fragrant oil, another a nauseous drug; one becomes a nutritious vegetable, another a virulent poison. Some plants have a natural provision against drought, others, by their shape, remain uninjured by either wind or rain; some open their flowers only when the heat of the day is past, while many more expand their petals, and elevate their heads, only at the light of the sun, closing them again, and folding them carefully up, at the approach of rain or of night. This is called the *sleep of plants*, and is in many instances so regular in its recurrence, as to indicate the time of the day.

> "Thus in each flower and simple bell.
> That in our path untrodden lie,
> Are sweet remembrances which tell
> How fast their winged moments fly."—Smith.

Plants may pass through the various stages of their existence in a few weeks or months: such as these are called *annuals*; others spring up, grow, and produce their conservative organs one year, and their flowers and fruit the next: these are *biennials*; while trees, shrubs, and many herbs are *perennial*, that is, of many years growth, increasing continually in majesty, utility, strength, and beauty.

But these, no less than their more fleeting companions, must at last arrive at the same termination, and although all are equally without the sense of feeling to appreciate the changes that constantly take place, yet plants are liable to many privations and casualties which might be thought to appertain alone to animal existence. Plants live and grow, though they cannot move—they select and take their food, though they have no mouth—their food digests, though they have no stomach—they breathe, yet without lungs—they sleep, yet know not that it is night—they have a natural heat, and fluid circulation, yet without a heart—they are benumbed by frost, revivified by warmth—are killed by poison, and by deprivation of nutriment—grow plethoric by superabundance—become more vigorous by stimulants, and during the whole period of their existence are subject to injury, disease, and death.

OXYGEN.

(Resumed from page 293.)

Ex. 16.—*Combustion of Phosphorus.* Instead of sulphur, (used in the last experiment), substitute a small piece of phosphorus, previously lighted. The vividness of the light now produced is so brilliant, that the eye can scarcely bear its intensity. A white flaky powder will escape, which is phosphoric acid. As this is extremely disagreeable, and excites coughing, the escape should be prevented, by the handle of the spoon passing through a cork fitting the top of the jar containing the oxygen.

Note.—In this experiment, as well as in any other in which heated phosphorus, lead, tin, antimony, or zinc, is to be fused or burnt, a brass spoon is to be used, and not a platinum one, as this metal unites to the substances mentioned, when they are red hot, with so energetic an action, that deflagration and detonation often ensue, to the imminent risk of the apparatus, and danger of the operator.

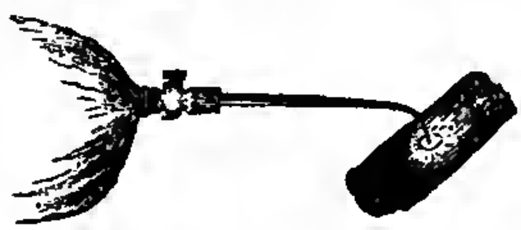
Ex. 17.—*Combustion of Phosphorus under Water.* Put a small portion of phosphorus into a deep glass, with as much cold water as will cover it. Then fill it up with *hot* water, and the phosphorus will be seen to melt. Press from a bladder, through a small metallic pipe, a stream of oxygen on the phosphorus, and a brilliant combustion will ensue under water.

Note.—In every experiment with phosphorus the greatest caution is necessary, it must be *cut under water*, and carefully *preserved in water*.

Ex. 18.—*Combustion of Homberg's Pyrophorus.* Drop into a jar, containing oxygen gas, a few grains of Homberg's pyrophorus. As soon as it enters the gas it inflames, and falls to the bottom of the jar in exceedingly brilliant sparks, like rain.

Ex. 19.—Suspend a piece of fine watch spring wire to a cork, which fits the top of a glass jar. Fasten a minute piece of phosphorus to the lower end of the wire, and immerse it in the jar when filled with oxygen, the phosphorus being first lighted. The wire will under these circumstances take fire, and burn gradually away, with the most beautiful scintillation. In this experiment the glass jar or receiver should hold at least a quart, and should have a little water at the bottom of it to catch the glowing sparks, which would otherwise pierce or crack the glass—these sparks are an oxyde of iron.

Ex. 20.—*Combustion of Zinc.*—Prepare a bladder, filled with oxygen, with a blow-pipe, a tapering tube, or a tobacco pipe stem, so that the gas within it may be pressed out in a fine stream, when required. This done, take a thick piece of charcoal, bore a small cavity in it, and in the cavity put some zinc filings. Light the charcoal around the metal, and urge it with the jet of gas from the bladder, the zinc will melt, become red hot, and finally be resolved into a beautifully brilliant whitish-blue flame. It is now uniting with oxygen, forming the white oxyde of zinc, which escapes in copious white fumes.



Ex. 21.—*Combustion of Lime.* Instead of the metals used before, make the experiment with a piece of lime, the size of a pea, which will soon become of so vivid and overpowering a light, that the eye cannot support it for an instant; it will cast a strong reflection upon the ceiling or a wall, so that the minutest objects may be discerned: it is in fact a modification of the well-known *Oxy-hydrogen Light*, or *Lime Light*, as it is indifferently called.

Ex. 22.—*Combustion of Antimony.* This metal burns so rapidly, as to be attended with a slight explosion. The flame is intensely white, and different from that of any other metal, forming what are called *argentine* flowers, or the white oxyde of antimony. Very brilliant sparks are generally thrown off during combustion.

Ex. 23.—*Splendid Combustion of Cast Iron.* Place in the hole of the charcoal a cast-iron *sparable*, or small nail. Urge it with the stream of oxygen, and presently it will inflame; and although the bladder of gas be then withdrawn, it will continue of itself to throw out a complete shower of the most intensely brilliant sparks, till the whole of the iron is consumed, or rather changed into an oxyde. This is one of the most beautiful experiments that even chemistry yields.

Ex. 24.—*Support of Animal Life.* Let two equal-sized jars be placed upon a table—one full of oxygen, the other of atmospheric air. Into each of them let a mouse be dropped. The animal immersed in the oxygen will live five times as long as that in the air, or in the exact proportion of the oxygen in the two vessels, as atmospheric air consists of one-fifth oxygen, and the rest nitrogen—the last not being fit for respiration. Lavoisier ascertained that a man consumes thirty-two ounces troy of oxygen gas in twenty-four hours.

Ex. 25.—In each of two jars, prepared as above—that is, one filled with oxygen, the other with air—immerse a lighted taper; one of the two tapers will burn five times as long as the other, showing that oxygen is necessary alike for combustion and respiration, and that it follows the same law in both instances—a valuable fact for the chemist, as it enables him to know the general effect of a gas upon respiration, without it being necessary to subject animals to torturing experiments.

Ex. 26.—*Causes of the Red Color of the Blood.* The blood when it enters the arteries is red—in its passage through the veins it becomes purple, and when it meets with oxygen in the lungs it again becomes red. This may be proved artificially, thus:—Withdraw quickly a phial, containing oxygen gas, and pour into it a spoonful of dark venous blood. Cork the bottle, and shake it up. The blood uniting thus with the oxygen will soon attain a bright vermillion color.

Ex. 27.—Pour into a large-mouthed phial some dark venous blood. Cork it well, and let it rest for some time. The blood will absorb all the oxygen in the common air of the bottle, as may be proved by inserting a lighted taper into the mouth, which will be quickly extinguished, there being no oxygen left to support combustion.

(Continued on page 325.)

SOAPS.

Soaps are divided into those that are soluble, and those that are insoluble. The latter are generally produced by double decomposition. It is the formation of these soaps that renders water, containing sulphate of lime, such as that drawn from wells dug in strata of the ternary formation, improper for washing; for in that case, a sulphate of potash or of soda is produced, and an insoluble soap of lime results, which is thrown down in flocculi. In order to use these waters, it is necessary to boil them previously, to remove the sulphate of lime, which they hold in solution in consequence of containing carbonic acid gas, and which is deposited when the gas is driven off by heat.

The soluble soaps are naturally divided into *hard* and *soft*; the former being produced by means of soda, and the latter of potash acting upon fatty substances. The fats and oils employed also exert considerable influence on the hardness of soaps. Tallows produce with the same alkali a harder soap than the oils, and of these latter bodies, the drying oils of linseed and poppy remain the softest. The soda or barilla used in all soaps is, before mixing with the other ingredients, rendered caustic by its solution in water, passing through a vat filled with quicklime, and having a false bottom through which it trickles.

COMMON HARD SOAPS.

Hard Soap.—Upon one ton of tallow put into the soap pan about 200 gallons of soda ley, of specific gravity 1·040 being poured, heat is applied, and after a very gentle ebullition for about four hours, the fat will be found to be completely saponified, by the test of a knife dipped into it, when it will be seen that the fluid will at once separate upon the steel blade from the soapy paste.

The fire being withdrawn, the mass is allowed to cool during one hour, after which the spent lye is drawn off, and a similar charge introduced as at first, and the boiling process is renewed and continued for the same time, and so on for six or seven times, increasing the strength of the lye each time. When boiled enough (a knowledge of which practice only will give,) the soap, now complete, is drawn off, and poured into frames, where, in twenty-four houre or more, according to the season of the year, it will have become sufficiently solid to be cut into squares for sale. The above ingredients, namely 20 cwt. of tallow, and 1½ cwt. of real soda, or 7½ cwt. of barilla will make 32 cwt. of good hard soap. Should the soda contain much sulphur, it will be of a blue color; should this be the case, it is diffused in a weak solution of soda, moderately heated, the blackish blue portion is precipitated, and the upper part being poured off forms a *white soap* often called curd soap; in this case the residue boiled again with rosin, or coarse animal substances, and other refuse, forms the coarse *yellow soap* of the shops. If after the mixture of the last solution of soda, the subsidence be disturbed by stirring the liquid a little now and then, and the whole be quickly cooled, the blue precipitate will be arrested and distributed throughout the mass in streaks, forming *mottled soap*.

Marbled Soap, such as is used for wash balls, &c. is chiefly a French manufacture. It is made by adding a small quantity of sulphate of iron during the first boiling. The alkali seizes the acid of the sulphate, and sets peroxyde of iron free to mingle with the paste, to absorb more or less oxygen, and to produce thereby a variety of tints, of black, brown, red and yellow. Marseilles is celebrated for a soap of this kind.

SOFT SOAPS.

The principal difference between soaps with base of soda, and soap with base of potash, depends upon their mode of combination with water. The former absorb a large quantity of it and become solid, they are chemical hydrates; the others experience a much feebler cohesive attraction, but they retain much more water in a state of mere mixture.

Three parts of fat afford in general, fully five parts of soda soap, well dried in the open air, but three parts of fat or oil will afford from six to seven parts of potash soap of moderate consistence. From its greater volubility, more alkaline reaction, and lower price, potash, or *soft soap*, is preferred for many purposes, and especially for scouring woollen yarn and stuffs.

Soft soaps are usually made in this country with whale, seal, olive, and linseed oils, and a certain quantity of tallow. When tallow is added, the object is to produce white and somewhat solid grains of stearic soap in the transparent mass, called figging, because the soap then resembles the granular texture of a fig. The process is as follows:—The potash of commerce is made perfectly caustic with lime, and in two solutions of different strengths; a portion of the oil is poured into the pan, and heated to nearly the boiling point of water, when some of the weaker lye is introduced. After boiling some time, more oil and lye are poured in alternately, till the whole is introduced; stronger lye is now added, and the boiling kept up very gently till the workman judges the saponification is complete, which is when the paste ceases to affect the tongue with an acrid pungency; when all milkiness and opacity disappear, and when a little of the soap, placed to cool upon a glass plate, assumes the proper consistency. 200 lbs. of oil require 72 lbs. of American potash of moderate quality, and the product is 460 lbs. of well boiled soap. The process occupies five or six hours.

SOFT TOILET SOAPS.

The soft fancy soaps are divisible into two classes. 1st. Good *potash soap*, colored and scented in various ways, forms the basis of the *Naples*, and other ordinary soft soaps of the perfumer. 2. *Pearl soap*, which differs from the other both in physical properties, and in mode of preparation.

Ordinary Soft Toilet Soap is conducted in its manufacture upon the above principles, the fat used being good hog's lard. The soap should have a dazzling snowy whiteness; be semi-fluid; and preserve always the same appearance: such soaps are in general request for shaving, and are most convenient in use, especially for travellers; hence their sale has become very considerable.

Pearl Soft Soap, or Almonde Cream. A French manufacture, which differs from the preceding chiefly in the details of its manufacture, which are as follows:—Weigh out 20 lbs. of purified hog's lard on the one hand, and 10 lbs. of potass on the other; put the lard into a glazed china or earthenware vessel, gently heated upon a sand bath, stirring it constantly with a wooden spatula, and when it is half-melted, and has a milky appearance, pour into it one half of the lye, (the potash it is supposed has been already dissolved in water and passed through quick lime,) still stirring and keeping up the temperature as equally as possible; after an hour or so we shall perceive some fat floating on the surface, like a film of oil, and at the same time the soapy granulation falling to the bottom; we must then add a second portion of the lye, whereon the granulations disappear, and the paste is formed. It must, however, be boiled three hours more, when it will become quite stiff; after cooling gradually it is to be pounded strongly in a marble mortar, along with the essence of bitter almonds, when it will be fit for sale.

HARD TOILET SOAP.

The soaps prepared for the perfumer are distinguished into different species, according to the fat which forms their basis. Thus there is a soap of tallow, of hog's lard, of oil of olives, of almonds, and palm oil. The mixture of these various kinds, differently scented, forms the numberless varieties sold under so many fantastic names.

Windsor Soap is made by mixing nine parts of good ox tallow, and one of oilve oil, scented with about one hundred parts by weight of the oil of carraway, oil of lavender, and oil of rosemary, in the following proportions:—

Hard Curd Soap, as above....	100 ounces.
Oil of Carraway............	1 ,,
Oil of Lavender............	½ ,,
Oil of Rosemary............	½ ,,

Soap a la Rose is made of the following ingredients:—

Olive Oil Soap..............	30 pounds.
Good Tallow Soap	20 ,,
Finely Ground Vermillion	1½ ounce.
Essence of Rose	3 ounces.
Essence of Cloves	1 ounce.
Essence of Cinnamon	1 ,,
Essence of Bergamot........	2½ ounces.

The hard soaps are to be kept at the heat of boiling water for an hour, with 5 lbs. of water in an untinned copper pan, the vermillion then added,

and when taken off the fire, the essences mixed well with it, by stirring them together. This is a very perfect soap, possessing a delicious fragrance, a beautiful roseate hue, and the softest detergent properties, which keeping cannot impair.

Soap au Bouquet.—

Good Tallow Soap	30 lbs.	
Essence of Bergamot	4 oz.	
Oils of Cloves, Sassafras and Thyme, each	1 oz.	
(Color) Brown Ochre	7 ,,	

Cinnamon Soap.—

Good Tallow Soap	30 lbs.
Palm Oil Soap	20 ,,
Essence of Cinnamon	7 oz.
Ditto, Sassafras	1½ ,,
Ditto, Bergamot	1½ ,,
(Color) Yellow Ochre	1 lb.

Orange Flower Soap.—

Tallow and Palm Oil Soap, as before, to which add of—

	Essence of Orange Flowers	7½ oz.
	Ditto Ambergris	7½ ,,
Color	Chrome Yellow	8 ,,
	Red Lead	2 ,,

Musk Soap.—

Tallow and Palm Oil Soap, as before, to which add of—

Powder of Cloves, Roses, and Gilly Flowers, each	4 oz.
Essence of Bergamot and of Musk each	3½ ,,
(Color) Brown Ochre	4 ,,

Bitter Almond Soap is made by compounding 50 lbs. of the best curd soap with 10 ounces of the essence of bitter almonds.

Transparent Soap.—Equal parts of tallow soap, made perfectly dry, and spirits of wine, are to be put into a copper still, which is plunged into a water bath; the heat applied to effect the solution should be as slight as possible, to avoid evaporating too much of the alcohol; the solution being effected must be suffered to settle, and after a few hours repose, the supernatant liquid is drawn off into tin frames of the form desired for the cakes of soap. These do not acquire their transparency till after a few weeks' exposure to a dry atmosphere: they are colored by a strong alcoholic solution of archil for the rose tint, and of turmeric for the deep yellow. Transparent soaps, however pleasing to the eye, are always of indifferent quality; they are never so detergent as ordinary soaps, and they eventually acquire a disagreeable smell.

Castile Soap is made of the coarser kinds of olive oil and soda, the color being given as described under marbled soap.

Cocoa-nut Oil Soap has been lately made in London, and is similar in its general properties to the ordinary palm soap, but has others of a remarkable kind, besides its dissolving with extreme rapidity; it will wash linen with sea water, hence it is often called marine soap, and is much bought for ship use.

MARBLING OF PAPER AND BOOK EDGES.

We presume that the following instructions for the marbling of paper will be of use to our readers generally. To bookbinders in country towns we know that they will be invaluable; and they must be serviceable to all others who have occasion to make use of marble paper, and wish to have it cheap. The first thing required is a *wooden trough*, made of inch deal, about one inch and three-fourths in depth, and half an inch in length and breadth larger than the sheets of paper that are to be marbled. This proportion between the size of the trough and paper should always be observed, to prevent waste of color; of course, troughs of various sizes will be required, where paper of various sizes is to be marbled. The trough must be water-tight, and the edges of the sides of it must be sloped or bevelled off on the outside, to prevent any drops of color which may fall on them, from running into the trough and sullying its contents.

A *Skimmer*, or clearing stick, must be provided for each trough: this is a piece of wood, two inches and a half wide, half an inch thick, and *as long* as the trough it belongs to *is wide* inside: the use of this will be explained hereafter.

A *Stone and Muller* of marble, or some other hard stone, the size according to the quantity of color required to be ground. Also a flexible knife, for gathering the color together.

A dozen or two of small glazed *pipkins* to hold colors in. The pots being furnished with

Brushes made as follows:—Take a round stick about as thick as your finger, and cut a notch all round one end of it; next, take some bristles, four or five inches long, and place them evenly round the stick, at the notched end, letting them project one inch and three-fourths beyond the wood; fasten the bristles to the stick by several turns of stout thread; cut away the ragged bristles, and tie up the brush firmly with fine cord. The use of the notch round the end of the handle is to make the bristles spread out, when firmly tied up, so that when used, the color may be scattered about more abundantly.

Rods for drying the paper on when marbled are better: they should be round, at least the upper side should, and about an inch and a quarter in breadth and thickness. Twelve rods 11 feet long will hang 3½ quires of demy, or 4½ quires of foolscap.

Colors:—of these use the following assortment,—*Red.* Vermillion, drop-lake, rose-pink, Venetian red, red ochre. *Blue.* Indigo blue, Prussian blue, verditer. *Orange.* Orange lead, orange orpiment, *Black.* Ivory, blue black. *Yellow.* Dutch pink, yellow ochre, king's yellow, English pink.

Now, with respect to grinding your colors; observe—*the finer your colors are ground, the better and the cheaper will your work be. First*, your colors should be finely pounded, then mixed with water to the consistence of paste, and put in a color pot with the knife. From the pot, the color must be taken out a little at a time, and levigated very fine with pure water.

Compound Colors are made by mixing the colors above-mentioned in certain proportions. The following may be particularized:—*To make a Red Color*, mix three parts of rose-pink, with one of vermillion. *A finer Red.* Four parts of rose-pink, two parts of vermillion, and one part of drop-lake; for very fine work use drop-lake alone, but use it very sparingly for it is a dear article. *Yellow.* Two parts of Dutch pink, and one part each of king's yellow and English pink. *Green.* Made by mixing blue and yellow. *Dark Blue.* Indigo; which may be made lighter by the addition of verditer. *Orange Brown.* Two parts of Venetian

red, and one part of orange lead. *A fine Orange.* Put some fine yellow ochre in e ladle over a fire, and keep it there till it assumes a dark red color. Take of this red ochre, fioely pounded, and of Venetian red equal quantities; and add a little orange orpiment or rose pink, mix all well together. *Umber Color.* Equal quantities of Venetien red, orange lead, and ivory black: this cao be lightened with orange lead, or darkened with ivory black. *Cinnamon Color.* Venetian red with a little Prussian blue. All other colors which may be wanted can he made by mixing together those already described, in a manner that will be dictated by experience.

In addition to the articles already mentioned, obtain the following: a bottle of ox-gall, a bottle of good oil of turpentine, and some pure water.

Supposing you to be provided with the materials for marbling, the next thing is to show you how to set about the operation. In the first place, the trough, already described, must he filled, at least to within an eighth of an inch of the top, with a solution of gum tragacanth, which is to be prepared as follows:—Gum of a pale white semi-transparent appearance (gum of n pure white or of a brownish color is often bad) is to be soaked in water for at least forty-eight hours, in the proportion of half a pound to a gallon and a half; this should make a gum water as thick as that used in miniature painting. Pass the solution of gum through a hair-sieve or linen cloth, and pour it into the trough. In all cases, when the trough is to be used, the solution should be well stirred up with a few quills, and the surface of it cleared from film, &c., by the skimmer above described.

Colors intended to represent Veins are made by adding a small quantity of gall to the various colors, and stirring each well up with a brush, in order that they may be properly mixed. Previous to use, these mixtures of color and gall are to be thinned with water to the consistence of cream, and are to be well stirred up.

Colors for producing Spots like Lace-Work. Take some dark blue, or other color, add some gall to it, and about as much, or a little less, oil of turpentine; stir all well together, and dilute with water.

Your trough being prepared, and your colora all at hand, it will now ba proper to try if the latter are in a proper state. To do this, throw on the solution, by shaking tha various color brushes over it, some spots of color. If the spots spread out larger than a crown piece in size, the colors have too much gall: if the spots, after spreading out a little, contract again, there is too little gall in them. In the one case more color must be added, in the other, more gall.

If the colors are in good order, and paper is to be marbled, the whole surface of the solution in the trough must be covered by colors, in spots, streaks, or whirls, according to the pattern required and laid on according to directions which will he given presently. The paper should be praviously prepared for receiving tha colors, by dipping it over night in water, and laying the sheets on each other with e weight over them. The sheet of paper must be held by two corners, and laid in the most gentle and even manner on the solution covered with the colors, and there softly pressed with the hand that it may bear everywhere on tha solution; after which it must be raised and taken off with the same care, and then hung to dry over the rods.

The following directions will serve to show how the various patterns are produced:—1. Throw on red till the solntion is nearly oovered, then some yellow, black, end green. You may add, if yo please, a little purple with plenty of gall and water in it; you may twist the colors into any shape you choose by means of a quill. 2. Throw on red, yellow, black, and green, as before; but, for a last color, add some of the dark blue mixed with turpentine. 3. Throw on red, yellow, black, and green in the proportion that you choose; then with a quill, draw lines through the colors; after which throw on a greater or less quantity of blue, green, pink, or purple, much diluted, and containing plenty of gall and turpentine. 4. Throw on very fina red for veins; then plenty of the turpentine blue. If your colors are good this produces a handsome pattern in a short time. 5. Throw on some dark blua mixed with turpentine, and take thia up with a paper previously stained of e yellow, light blue, red, pink, or green color. To obtain a good green for this purpose, boil French berries in water, add a little spirit or liquid blue, and carefully brush over the paper, which must be good and well sized, with this mixture.

A few general and recapitulatory observetions may not be useless here. Let your meterials be of the best quality. Grind your colors finely, and keep them clean. When your colors become too thick for use, add fresh ground color with water and a little gall to them, and stir them up well. Be particular in getting good turpentine. When the solution of gum gets dirtied throw it eway and make a fresh one.

The neatest and most convenient method of marbling the edges of books, is to dip one volume at a time, doing the ends first, and throwing back the boards to do the fore-edge; observing to hold the book tight with both hands, and not to dip deeper than the surface, to prevent the solution from spoiling the book. It is the safest way, probably, to tie the book between hoerds before dipping. And, for the sake of convenience and economy, when only a few books are to be marbled, a small trough should be used.

Marbled paper is glazed by a machine similar to that with which cottons are glazed, a sight of which may easily be had at any calenderers. But e machine of this kind would only be required by such as might marble very largely. Book-edges are polished by the agate burnisher, and so might smell pieces of paper be polished, which were required for any particular purpose. Good common pressing, or at farthest hot-pressing, might serve as well as glazing. For any fancy work it would have e fine effect to varnish the marble paper after it had been put to its destined purpose, and had becoma dry. Paste and all moisture, it is well known, chase all the glaze away. The application of a coat of varnish subseqnant to the application of paste would double tha beauty of the best marble paper made, and much improve tha common kind, at a trifling expense.

MISCELLANIES.

Animals in Whiting, Chalk, &c.—An examination of some of the finest powdered sorts of chalk which are used in trade has afforded Professor Ehrenberg the following result, that even in this finest condition not merely the inorganic part of the chalk is become separated, but that it remains

mixed with a great number of well-preserved forms of the minute shells of coral animalcules. As powdered chalk is used for paper-hangings, Professor Ehrenberg also examined these as well as the walls of his chambers, which were simply washed with lime, and even a kind of glazed vallum paper called visiting cards, and obtained the very visible result—demonstrating the minuteness of division of independent organic life—that those walls and paper-hangings, and so doubtless all similar walls of rooms, houses, and churches, and even glazed visiting cards, prepared in the above-mentioned manner (of which cards, many however, are made with pure white lead, without any addition of chalk) present, when magnified 300 diameters, and penetrated with Canada balsam, a delicate mosaic of elegant coralline animalcules, invisible to the naked eye, but, if sufficiently magnified, more beautiful than any painting that covers them.—*Poff. Ann.*

Transferring Impressions of Old Prints.—One of the most ingenious inventions we have witnessed for many a day is a process, invented by Mr. Joseph Dixon, for transferring impressions to stone. The discovery was made some seven or eight years since, and, by its means, new and exact impressions of the leaves of old books, bank bills, engravings, &c. may be obtained in an incredible brief space of time. The celerity and exactness of the work are truly remarkable. A bank bill was transferred by Mr. Dixon, in presence of the officers of the bank, with so much fidelity and precision that the very signers of the bill could not tell the difference between the copies and the original. It is due to Mr. Dixon to state, that he has obtained a patent for the process by which bank bills can be protected from his own invention, should it ever fall into the hands of rogues. The importance of the discovery is in nowise inferior to that of the Daguerréotype, of which we have heard so much within the last half-year.—*New York Mirror.*

Gas by a New Process.—An experiment in gas lighting by the Count do Val Marino was made yesterday evening on a piece of waste ground at the back of Fetter Lane. A small gasometar was erected, which was connected by tubes to a furnace containing three retorts, one of which was partly filled with water, a second with tar, and both being decomposed in the third retort, formed the sole materials from which the gas was produced. The process appeared to be extremely simple, and the novelty of the experiment consisted in the fact, that the water and tar were the only materials employed, though the inventor says, that any kind of bitumen or fatty matter would answer the purpose equally well. After the lapse of about half an hour after the commencement of the process; the gas was turned into the burners, and a pure and powerful light was produced, perfectly free from smoke and unpleasant smell. The great advantages of this kind over that produced from coal, consists, it is said, in the cheapness of its producing materials, the facility with which it is manufactured, and the perfection to which it is at once brought, without the necessity of its undergoing the tedious and expensive process of condensation and purification; for in this instance, as soon as the preliminaries were completed, the light was produced in a perfect state, within a few feet of the gasometer, which, although of inferior size, was said to be capable of affording light for 10 hours to at least 500 lamps or burners. The price ... will be, it is estimated, not more than one-third that of coal gas—equally available for domestic use—and such that small gasometers might, at a trifling expense, be fitted up at the back of grates in private dwellings, from which the gas could be conveyed in Indian rubber bags to any part of the house, thereby preventing the many accidents which occur by the use of tubes or pipes.—*Times, Dec.* 17.

Vegetable Origin of the Diamond.—One of the most striking physical investigations that have lately occurred, is that of Sir D. Brewster by which he has further shown the probable vegetable basis of the diamond. He had previously remarked several peculiarities of structure in this gem, which inclined him to assign it an organic origin. Thus, for example, having detected a bubble of air in a diamond, Sir David transmitted through it a pencil of polarized light, and perceived round the bubble four luminous sectors, separated by the black cross. Now this could only be accounted for by assigning a variable density from the centre to the exterior, greatest against the bubble of air, which must have exerted a degree of compression on the matter in contact with it. On other occasions, Sir D. Brewster had remarked in certain diamonds interposed carbonized parts. At the recent Liverpool meeting, this philosopher communicated what he conceived to be a novel phenomenon; but it has been remarked in France in the diamond lenses prepared by M. Oberheuser; namely, an infinity of very fine parallel lines, which are perceived in the diamond in a certain direction, and which are very prejudicial to its employment in the construction of lenses. These lines had been regarded in France as fibres, or as fine channels. Sir D. Brewster considers them as separating so many layers of variable densities; he counted many hundreds of them in less than the one-thirtieth of an inch, and to them he attributes the duplication of the images, which were formerly supposed to be due to an ordinary effect of double refraction. He is consequently led to imagine that if diamond lenses were worked parallel to the direction of these layers, or, so that their axis was exactly perpendicular, they would not be influenced by the presence of these lines; the lens would act precisely as if the diamond were perfectly homogeneous.

Sir David states, that he has not observed this structure resulting from an assemblage of fine laminæ of varying densities in any other mineral, not even in apophyllite or chabasite, which present different degrees of extraordinary refraction in different points of the crystal, depending on a secondary law of structure. Sir David, therefore, thinks this special structure in the diamond to be a new indication of its vegetable origin, and that it was formed by the successive deposition of layers submitted to different pressures.—*Arcana of Science.*

ANSWERS TO QUERIES

149—What are the toys called sensitive leaves, and how made? *Answered on page* 312.

150—How are animal skeletons prepared and whitened? *Answered on Vol.* 2, *page* 157.

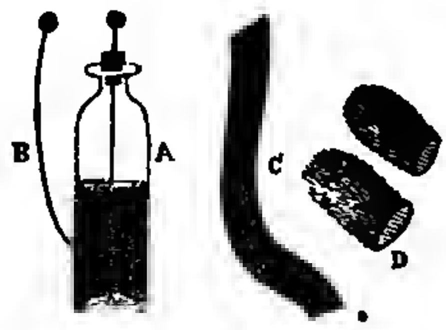
151—What is madder carmine, and how prepared? *Answered on page* 412.

152—What threshing machine is applicable to clover seed? *Answered on page* 414.

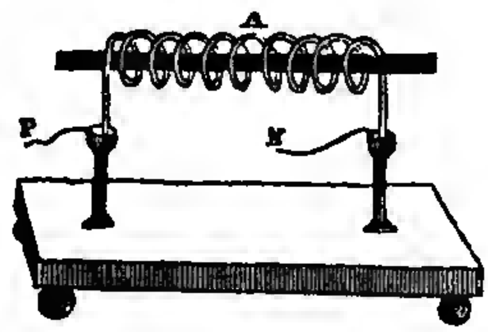
153—How is sheel wax made? *Answered on page* 312

154—How is rice paper made, and of what? *Answered on page* 367.

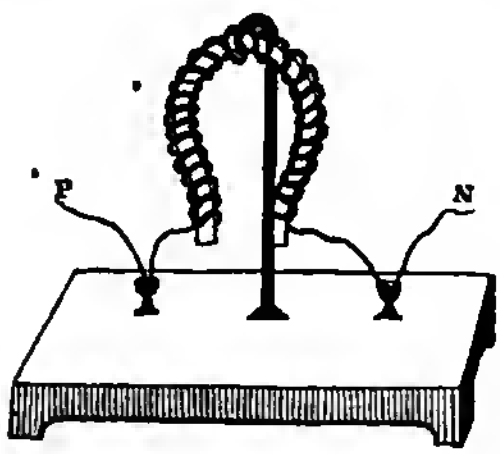
Fig. 1.



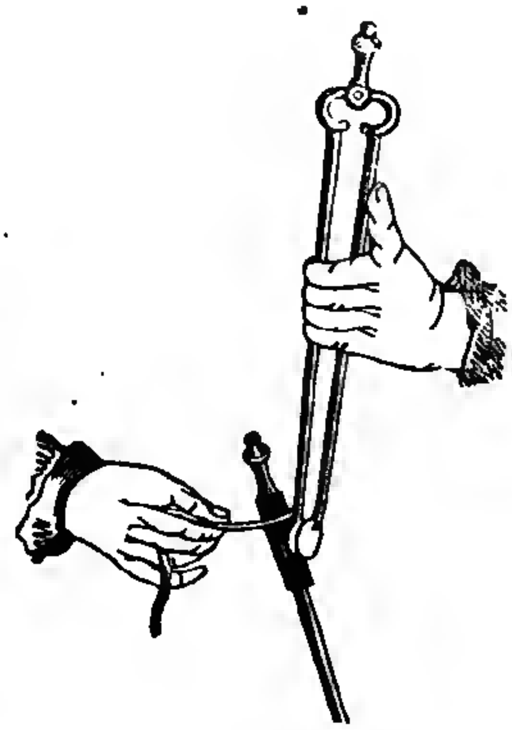
2.



3.



ON MAKING AND PRESERVING ARTIFICIAL MAGNETS.



4.

5.

ON MAKING AND PRESERVING ARTIFICIAL MAGNETS.

The methods employed by scientific persons to make artificial magnets are numerous. They naturally divide themselves into two distinct classes: in one we are supposed to have one or more artificial magnets, by whose assistance we are desirous of making others; and in the second class it is to be imagined that we have no one to begin with, but merely the bar or wire of steel of which we are desirous a magnet should be made. This division of the subject it will be most advisable to treat of first, leaving the former for a future opportunity.

First. By Electro-Magnetism.—It is a well-known fact in this science, that when a current of electricity is made to circulate around a bar of iron or steel, it induces in that steel magnetic properties, and that in a single instant; thus it forms a ready method of forming artificial magnets, both such as are straight, as well as those which are of the horse-shoe form. The apparatus usually employed for this purpose is as follows:—Let A, Fig. 2, represent a wire coiled round a straight bar of soft iron, and let the ends of the coil dip into the two small cups, from which issue also two other wires, P and N, supposed to be connected with the positive and negative sides of a quart galvanic jar, in action.

The very moment the connection with the poles of the battery is made, the soft iron bar will be found a powerful magnet, capable of holding a considerable weight: the bar being of soft iron only, loses its attractive and directive property as soon as its connection with the battery is cut off.

If, instead of the iron bar, one of hard steel be substituted, the magnet thus made will be permanent in its properties, forming as perfect a magnet as need be desired for ordinary purposes. It is not necessary that it should remain within the coil any length of time, as all the virtue it acquires is conveyed to it instantly.

Electric Horse-Shoe Magnets may be made by the same method both temporary and permanent, by substituting a piece of iron or steel in that shape, and connecting it with the battery in a proper manner. See Fig. 3.

Produced by Tortion.—This method was proposed by Gay Lussac, as one available under circumstances in which other methods are unattainable, as for example, the making of a compass needle, when cast away by shipwreck and other circumstances, in which a weak and delicate needle is all that is required.

Make a piece of iron wire, (the thinner the better,) very soft, and suspend it vertically, it will be found a magnet; to render the magnetism thus induced permanent, put the lower end of the wire in a vice, the cleft of a stick, or any thing that will hold it firmly; now twist the wire till it breaks, and it will be found very hard and a permanent magnet.

By Percussion.—A very simple and efficacious method has been published by Mr. Scoresby, in the "Philosophical Transactions," for 1822, p. 241. That iron becomes magnetic when struck by successive blows of a hammer, in the direction of the dipping needle, or about the position in which the tongs is held in Fig. 4, was known to Dr. Gilbert in the year 1600, but it is to Mr. Scoresby that we owe a complete investigation of the subject. In order to determine the effects produced by percussion, Mr. Scoresby used two methods: the one by observing the weight which the new magnet lifted; and the other, by measuring the deviation which it produced on a magnetic needle. The experiments were made with a bar of soft steel, six and a half inches long, one-fourth of an inch in diameter, and weighing 592 grains; it was placed in a vertical position, resting on a piece of tin, and struck on the top with a hammer of twelve ounces. The greatest effect was produced by about eighteen blows. When the steel bar was placed upon a stone, the effect was the same; but a great increase of power was obtained by supporting the lower end of the bar upon the upper end of another and larger bar, and striking it with a larger hammer.

From the results of his experiments Mr. Scoresby deduced the following, as the proper application of his method of magnetising. He says:—

"I procured two bars of soft steel, thirty inches long and an inch broad, also six other flat bars of soft steel, eight inches long and half an inch broad, and a large bar of soft iron. The large steel and iron bars were not, however, absolutely necessary, as common pokers answer the purpose very well; but I was desirous to accelerate the process by the use of substances capable of aiding the developement of the magnetical properties in steel. The large iron bar was first hammered in a vertical position; it was then laid on the ground with its acquired south pole towards the south, and upon this end of it the large steel bars were rested while they were hammered; they were also hammered upon each other. On the summit of one of the large steel bars, each of the small bars held also vertically, was hammered in succession; and in a few minutes they had all acquired considerable lifting powers. Two of the smaller bars, connected by two short pieces of soft iron in the form of a parallelogram, were now rubbed with the other four bars, in the manner of Canton. These were then changed for two others, and these again for the last two. After treating each pair of bars in this way for a number of times, and changing them whenever the manipulations had been continued for about a minute, the whole of the bars were at length found to be magnetised to saturation, each pair readily lifting above eight ounces.

"In accomplishing this object I took particular care that no magnetic substance was used in the process. All the bars were freed of magnetism before the experiment, so that none of them, not even the largest, produced a deviation of five degrees on the compass at three inches distance. Any bars which had been strongly magnetised, and had had their magnetism destroyed or neutralized (either by hammering, heating, or by the simultaneous contact of the two poles of another magnet placed transversely,) I always found had a much greater facility for receiving polarity in the same direction as before then the contrary. Hence it generally happened that one blow with the original north end downwards, produced as much effect as two or three blows did with the original south end downwards."

By this ingenious process, any person who has no magnets within his reach may communicate the strongest degree of permanent magnetism to hard steel bars of any magnitude, the bars magnetised by percussion being employed, as in the process of Coulomb, to magnetise the larger bars which are required.

By the Solar Rays.—Mrs. Somerville made some simple and well conducted experiments on the

effect of the violet rays of the solar spectrum, in communicating permanent magnetism. A sewing needle, an inch long, and devoid of magnetism, had one half of it covered with paper, and the other exposed to the violet rays, 5 feet distant from the prism which refracted them; in two hours it acquired magnetism, the exposed end exhibiting north polarity. The indigo rays produced an equal effect, and the blue and green the same in a less degree. The yellow, orange, and red rays had no effect, even after three days exposure to their action; pieces of blue watch spring received a higher magnetism. When the sun's light fell upon the exposed end, through blue colored glass, or through blue or green riband, the same magnetic effects were produced.

Mr. Canton's Method of Friction.—" Take a poker and tongs, or two bars of iron, the larger and the older the better, and fixing the poker upright, as in Fig. 4, hold to it with the left hand, near the top, by a silk thread, one of the *soft* bars, having its marked end downwards; then grasping the tongs with the right hand, a little below their middle, and keeping them nearly in a vertical line, let the bar be rubbed with the lower end of the tongs, from the marked end of the bar to its upper end, about ten times on each side of it. By this means the bar will receive as much magnetism as will enable it to lift a small key at the marked end; and this end of the bar being suspended by its middle, or made to rest on a point, will turn to the *north*, and is called its *north* pole; the unmarked end being the *south* pole.

To preserve Magnets.—Magnets should, when laid aside, be placed as nearly as possible in the position which they would assume in consequence of the action of terrestial magnetism; if this be neglected, in process of time they will become gradually weaker; and this deterioration is most accelerated when its poles have a position the *reverse* of the natural one. Under these circumstances, indeed, unless the magnet be made of the hardest steel, it will eventually lose the whole of its magnetic power. Two magnets may also very much weaken each other, if they be kept, even for a short time, with their *similar* poles fronting each other. This will readily be understood from what has been said with regard to magnetic induction. The polarity of the weaker magnet is rapidly impaired, and sometimes actually reversed. All rough and violent treatment of a magnet should also be carefully avoided: every concussion or vibration among its particles tends to weaken its power.

Horse-shoe magnets should have a short bar of soft iron, adapted to connect the two poles; and should never be laid by, without such a piece of iron adhering to them, and with a weight attached, as in Fig. 5. If hung up in this position, and the weight gradually increased day by day, its lifting power will increase very materially. Bar magnets should be kept in pairs, with their poles turned in contrary directions, and the dissimilar poles on each side connected by a bar of soft iron, so that the whole may form a parallelogram. They should fit into a box when thus arranged, so as to guard against accidental concussion, and to preserve them from the dampness of the atmosphere. They should be polished not with a view of increasing their magnetism, but because they are then less liable to contract rust. Both single magnets and needles have their power not only preserved but increased, by keeping them surrounded with a mass of dry filings of soft iron, each particle of which will re-act, by its induced magnetism upon the point of the magnet to which it adheres, and maintain in that point its primitive magnetic state.

In the " Compte Rendu" for January 2nd, 1838, there is an important notice of a communication received from M. de la Rive, relative to the magnetising of needles, by the *nerves*. The following is an extract:—" Dr. Prevost, of Geneva, has succeeded in magnetising very delicate soft iron needles by placing them near the nerves, and perpendicular to the direction which he supposed the electric current took. The magnetising took place at the moment when, irritating the spinal marrow, a muscular contraction was effected in the animal."

SIMPLEST ELECTRICAL JAR.

MANY persons are desirous of constructing an electrical apparatus sufficient for giving shocks, without the cumbrousness and expense of the usual machine. The following may assist them in this intention:—

A, Fig. 1. is a common phial, (the larger the better,) having a little water inside, corked tightly, and with a wire running through the cork to the bottom of the jar, and having a brass ball or a bullet upon the top of the wire outside. The phial is covered up to a certain height outside, as represented, with tea lead, or tinfoil, or something similar; D are two cat-skin rubbers, made like finger-stalls, and are to be used on the thumb and fore-finger of the right hand, a fur glove will answer still better; C is a black silk ribbon, about 30 inches long; B is a wire with a ball at the end, to act as a discharger for the phial when in use; it is to be bent and applied so as to discharge the electricity from the jar.

To use this apparatus; warm and dry the phial, &c. on the outside, also warm the ribbon well; put the phial on a table without the discharger attached to it, and holding the warmed ribbon by its end in the left hand, draw it through the thumb and finger which is furnished with the fur caps, holding it so that it may pass over and touch the knob of the phial. The friction of the ribbon and fur will excite them, and the electricity thus disturbed will charge the phial. Repeat this briskly 15 or 20 times, and the phial will be found charged with fluid, and capable of giving a shock when discharged, as may be proved by holding the jar by its outward coating, (which may be done without danger of a shock,) and also in the same hand, in contact with the coating, the wire end of the discharging rod. Upon bringing the ball of this to the ball of the phial, the shock will pass, and a snap, according to the size of the bottle, be heard. Another way of charging this simple apparatus is given thus, in " Adams's Electricity:"—

To Charge the Jar.—Place the two finger-caps, D, on the first and middle finger of the left hand; hold the jar, A, at the same time at the edge of the coating on the outside, between the thumb and first finger of the same hand; then take the ribbon in your right hand, and steadily and gently draw it upwards between the two rubbers, D, on the two fingers, taking care at the same time the brass ball of the jar is kept nearly close to the ribbon, while it is passing through the fingers. By repeating this operation twelve or fourteen times, the electrical fire will pass into the jar, which will become charged, and by placing the discharger, C, against it, as shown in the figure, you will see a sensible

spark pass from the ball of the jar to that of the discharger. If the apparatus is dry and in good order, you will hear the crackling of the fire when the ribbon is passing through the fingers, and the jar will discharge at the distance of about half an inch between the balls."

If the shock is to be passed through the arms of several persons, they must join hands: the person at one end of the line must hold the knob of the discharger; and when the person at the other end touches the knob of the phial the shock will pass through them all, and according to its strength be felt at the fingers, wrists, elbows, or chest.

Mr. Cevallo describes a still more simple apparatus for producing the electric charge, though not so portable as the above, which he calls the *self-charging Leyden phial*, and thus describes:— "Take a glass tube of about 18 inches in length, and an inch, or an inch and a half in diameter, it is immaterial whether one of its ends be closed or not. Coat the inside of it with tin foil, but only from one extremity of it to about as far as its middle; the other part, which remains uncoated, we shall call the naked part of the instrument. Put a cork to the aperture of the coated end, and let a knobbed wire pass through the coat, and come in contact with the coating. The instrument being thus prepared, hold it in one hand by the naked part, and with the other hand clean and dry-rub the outside of the coated part of the tube; but, after every three or four strokes, you must remove the rubbing hand, and must touch the knob of the wire, and in so doing a little spark will be drawn from it. By this means the coated end of the tube will gradually acquire a charge, which may be increased to a considerable degree. If then you grasp the outside of the coated end of the tube with one hand, and touch the knob of the wire with the other hand, you will obtain a shock, &c.

"In this experiment, the coated part of the tube answers the double office of electrical machine and of Leyden phial; the naked part of it being only a sort of handle to hold the instrument by. The friction on the outside of the tube accumulates quantity of positive electricity upon it, and this electricity in virtue of its sphere of action, forces out of the inside a quantity of electricity also positive. Then by taking the spark from the knob, this inside electricity, which is by the coating communicated to the knob through the wire, is removed, consequently the inside remains undercharged or negative, and of course, the positive electricity of the outside comes closer to the surface of the glass, and begins to form the charge. By further rubbing and taking the spark from the knob, this charge is increased, &c."

ULTRAMARINE.

This substance, which is one of the most brilliant colors of the palette, is also one of the most lasting. It is produced from lapis lazuli (lazulite), a hard species of stone, found in Persia, China, and Great Bocharia. The stone is not uniform in its color; it often has white veins like marble, and is sprinkled with points and veins of a golden lustre. There are also ferruginous pyrites in it; that is, combinations of iron and sulphur. Having chosen portions of this stone free from veins and pyrites, it is only requisite to reduce it to an impalpable powder, when it forms a fine blue color. Probably this was the original mode of preparing it, before the discovery of the process by means of which the color is separated from other matter which would tarnish it.

The lazulite is first broken into small pieces, to give an opportunity of cutting away, with steel scissors, the white veins that may be found; all the parts that are of a fine color must then be put into a crucible, and brought to a red heat; and when the matter is in this state, it is to be thrown into cold water.

As the lazulite will sustain a red heat without changing color, the object of the operation is to facilitate the trituration of the stone.* The pieces are then taken out of the water, then pounded in an iron mortar, passed through a sieve, and ground with water on porphyry or glass: a strong tenacious paste is thus formed; this is dried, and produces a blue powder, more or less tinged with grey, according to the quality of the stone. This powder is then intimately blended with an equal weight of resinous paste, composed of new wax, Burgundy pitch, gum mastic, turpentine, and linseed oil, in such proportions, that when the powder is combined with it, the paste shall still continue pliant and manageable. This mixture, of course, must be united by heat, and the melted mass is then thrown into a dish full of water. It is kneaded at first with two spatulas of wood, and with the hands when it is cold enough for that purpose. It is formed into rolls, which are put into a vessel full of water, where they must remain fifteen days, renewing the water occasionally: this process causes a fermentation, by which the oxide of iron from the decomposed pyrites adheres still more closely to the mastic, in the same degree that the blue powder of the lazulite separates from it. The paste is then pressed in a close vessel of water, when the ultramarine exudes, and colors the water.

The first issue of the color is the most brilliant: for this reason the products are divided into three or four different classes, or grades of strength; but when no more color can be gained by cold water, another issue can be obtained with the aid of warm water. When at length nothing further can be procured in this way, the addition of a little soda to the mastic will draw out what is called the ashes of ultramarine, which is a mixture of a small portion of the mass, a little oxide of iron, and a small portion of the color, forming a grey, of a more or less bluish tint. The ultramarine is then washed in boiling water, which carries off a little of the resinous matter mixed with it, and which lowers the brightness of its tone.

Although this color can sustain a red heat without losing any color, yet it may be destroyed by acids, which give the means of ascertaining its purity in the following manner:— A pinch of this color being put into a glass, and some nitre thrown upon it, the blue color is destroyed in a moment, only an earthy matter remaining, of a yellowish grey color, and the appearance of jelly. Neither cobalt nor Prussian blue are changed by the acids, so that when ultramarine is adulterated by one of these articles, the fraud is easily discovered. A solution of indigo is not bright enough to tempt any one to use it in the fabrication of ultramarine, but should it be attempted to heighten the tone of ultramarine by this substance, the sulphuric acid will soon discover it, as this acid does not act upon indigo.

FLOOR-CLOTH MANUFACTURE.

Read at the Royal Institution,

BY MR. BRANDE.

THE main part of the manipulation is similar to calico-printing, the figures upon the blocks being upon a much larger scale, and the cloths which are printed being of an infinitely greater size. The common dimensions of a floor-cloth are 210 or 220 square yards, and hence the immense size and often unseemly appearance of floor-cloth works. A stout canvass is chosen in the first instance. This is nailed to one extremity of a wooden frame, and stretched by means of hooks which are attached to the other sides. It is then washed with a weak size and rubbed over with pumice stone. No other substance has yet been found which answers the purpose so well as this mineral. The next step is that of laying on the color, which is performed by placing dabs of paint over the canvass with a brush, and then rubbing or polishing it with a long peculiar shaped trowel. Four coats of paint are thus applied in front and three on the back of the cloth. To remove it from the frame when these processes are finished, a roller on a carriage is employed, upon which it is rolled and conveyed to the extremity of the manufactory for the purpose of being printed.

It is then gradually transferred from the roller, and passed over a table which is 30 feet long and 4 feet wide, made of planks placed vertically, and as it proceeds over the table, the blocks, dipped in the appropriate colors, are applied. The colors used are ochre, umber, vermillion, and different kinds of chrome, mixed up with a little linseed oil and a little turpentine.

The number of blocks applied to one pattern depends upon the number of colors.

The first mode of applying the patterns was by stencils, that is, the pattern was cut out in paper, and when the paper thus prepared was applied to the cloth to be painted, that portion where the ground was exposed by the interstice in the paper was traversed by a brush. Then a combination of stencilling and hand printing was had recourse to, the former process being first made use of, and then a block was applied, the stencilling forming the groundwork. Stencilling is now abandoned. In printing, it is necessary that the cloth should first be rubbed over with a brush, else the colors will not adhere. Whether the effect is electrical or not has not been ascertained. Every square yard of good oil-cloth weighs 3½ or 4½ lbs., each gaining by the application of the paint 3 or 4 lbs. weight, and hence, the quality of this manufacture is judged of by the weight. Whiting is often used in spurious cloths, mixed with oil. Cloth prepared in this way speedily cracks and becomes useless.

Good cloth, with a very stout canvass, is used for covering verandahs, and will last nine or ten years, while spurious cloth will become useless in one year. Floor-cloth is employed to cover roofs, as at the manufactory at Knightsbridge, and for gutters. In the latter case it is remarkable that water remaining in contact with it produces no injurious effect.

Painted baize for tables is usually manufactured with a smooth side, and is printed with blocks of a fine structure resembling calico blocks. Fine canvass is employed; several coats of paint are laid on upon one side, and the other receives one coat, and is then strewed over with wool, or flocked, as it is called.

POLISHING MARBLES, &c.

THE following is the process of polishing the most common sorts of marble:—If the piece to be polished is a plane surface, it is first rubbed by means of another piece of marble, or hard stone, with the intervention of sand (of two sorts) and water; first, with the finest river or drift sand, and then with common house or white sand, which latter leaves the surface sufficiently smooth for its subjection to the process of gritting. Three sorts of grit stone are employed: first, Newcastle grit; second, a fine grit brought from the neighbourhood of Leeds; and, lastly, a still finer, called snake grit, procured at Ayr, in Scotland. These are rubbed successively on the surface with water alone; by these means the surface is gradually reduced to that closeness of texture fitting it for the process of glazing, which is performed by means of a wooden block having a thick piece of woollen stuff wound tightly round it; the interstices of the fibres of this are filled with prepared putty powder, or per-oxide of tin, and moistened with water: this being laid on the marble and loaded, it is drawn up and down the marble by means of a handle, being occasionally wetted, until the desired gloss is produced.

The polishing of mouldings and enrichments is done with the same materials, but with rubbers varied in shape according to that of the moulding or enrichment. The block is not used in this case; in its stead a piece of linen cloth, folded to make a handful: this also contains the putty and water.

With regard to the size of the sand rubbers employed to polish a slab of large dimensions, they should never exceed two-thirds of its length, nor one-third of its width; but if the price of marble is small, it may be sanded itself on a larger piece of stone. The grit rubbers are never larger than that they may be easily held in one hand; the largest block is about fourteen inches in length and four inches and a half in breadth.

Eaine, or Inflammable Snow.—Hermann, of Moscow, examined a substance termed inflammable snow, which fell on the 11th April, 1832, thirteen versts from Wolokalamask, and covered a considerable space of ground, to the depth of 1 to 2 inches. Color, wine-yellow, transparent; soft and elastic, like gum; sp. gr. 1·1; smelling like rancid oil; burns with a blue flame, without smoke; insoluble in cold water; soluble in boiling water, upon which it swims; soluble in boiling alcohol; dissolves also in carbonate of soda, and acids separate from the solution a yellow viscid substance, soluble in cold alcohol and which contains a peculiar acid. Analyzed by oxide of copper it gave

Carbon . . .	61.5
Hydrogen . . .	7.0
Oxygen . . .	31.5
	100

He has named it *eaine*, or oil from heaven.

THE CAUSE OF PLANETARY MOTION.

THAT motion occasions all the changes which take place in the material world cannot be doubted; all chemical change is occasioned by the motion of the particles of bodies among themselves, and electrical, galvanic, and magnetic effects are occasioned by the constant motion of some all-powerful and universal fluid or influence; attempts therefore to assimilate these effects and to simplify the laws which govern

them has naturally ettracted the attention of philosophere in every age and country, more especially to explain the beavenly bodies. Their efforts, however, have been principally directed to ascertain the laws by which thet motion eppeare to be regulated, rether than the canse of it. It is ascertained thet the planets are retained in their orbits by the centripetal and ceutrifugal forces. But why do these bodies move at all? Why do they turn on their axes, and revolve in stated orbits? Of what neture are those forces called centripetal and centrifugal; ere they forces *per se;* are they electrical or magnetic? The present state of science seems to indicate the latter, and the object of this paper is to bring forward a few arguments to prove the rationality of this opinion, end to adduce some experiments in support of it. I shall he allowed, perhaps, to mske e supposition, and then show bow far fscts will corroborate or negative our position.

I imagine the sun, which is known to be the centre of our system, and consequently the centre of attraction for all the planets. to contain a loadstone, equal, or nearly epual, to his polar diameter, or in other words, a magnetic current or energy iu the direction of its axis, for here the word loadstone is only used for the sake of convenience: and the remaining part of his hulk to be composed of some beterogeneous mass, somewhat similar to the crust of our earth; and that all the bodies of the system are similarly constituted. If we can but prove that this supposition is correct, the very formation of the planets will cause their various motiona, and they will contain the principals of motion in themselves: for example, the sun from its containing a loadstone within its hulk, will attract the loadstones of the worlds which rotate arouud him, and with a power proportioned to their magnitudes and the square of their distances, as is attributed to gravitation, and the crust or outer surface of these bodies, from their nature, would rotate upon their axes, because their surfeces are galvanic and their axes magnetic. The galvanic power inherent in the sun, the planets, and their moona would also prevent them approaching the sun too nearly, and as there is probably nothing in nature to weaken ur augment the aggregate of either of these forces, they take that distance et which the powera that move them counterbalance each other, and remain in the same orbit in which these forces, at first placed them.

The above is, I am aware, a bold assumption, and it becomes me well to consider what argoments I can adduce ln support of it; to do this intelligibly it will be proper to allude to the facts at present kuown of galvanism and magnetism, and argue from them, for minute as our experiments are compared to the mighty scale of neture, yet, depending for their effect ou natural causes, we may be enabled to discover something relative to the cause of that motion which regulates the universe; and not only this, but perhaps the investigation may afford us reason to ettribute light end heat to the same origin, and pursuing the same train of research, future philosophere may discover, thet not only earthquakes and volcanoes, but the whole extensive chain of chemical phenomena, composition, and decomposition, combustion, and crystallization are to be imputed to the same mighty agent—galvanism. But to facts—a magnet attracts all bodies susceptible of magnetism iu a ratio inversely as the square of its distance from them, and it mey be easily proved that all metals when made a passage for the galvanic fluid are magnetic; Mr. Christie, Professor Cumming, Dr. Trail, Sir H. Davy, and others hava said, that in all bodiea whatever, even in stones, some degree of magnetism may be elicited.

But we are obliged to depend upon the mere opinions of men however eminent, we can go far to PROVE thet this is the case; Sir H Davy has decomposed potass, soda, and some of the earths, changing them ioto metals, and has carried on bis researches so far as to leave no doubt that all the other earths are metallic also, and it may easily be shown that all metals are influenced by currents of magnetism or galvanism. This is a strong argument in favor of our hypothesia, as it showa us why all bodies around us edhere or are ettracted to the earth's surface, and supposing the sun to be magnetic also, why the planets do not fly off into boundless space: and in passing, I may mention that the diurnal variation of the magnetic needle follows the course of the sun, and that the sun's rays also effect the needle, and disturb its directive power. But this is not the only surprising fact relative to the subject, on the coutrary, every succeeding observation instead of vitiating the conclusion I have drawn, seems to corroborate it. The cause of the earth's rotation upon its axis appears not yet to have been discovered; astronomers have, indeed, well ascertained that it does rotate, and I cannot doubt that they have accurately measured the time of its rotation, but the cause of this motion is not defined; one has attributed it to subterraneous fire; another to internal waters; a third to electrical agency. Perhaps a modification of the latter, joined to the power of an internal magnet will cause the motion; for what I have supposed to be the constituent formation of the sun is really known to be true as it respects the earth; there is within our globe e powerful magnetic current, whose poles are nearly those of the earth's rotations; that the outer surface of the earth is galvanic is elso evident; it is composed of strata of dissimilar metals separated from each other by layers of imperfect conductors; it also abounds in acids and water in contact with them, thus forming active and extensive galvanic circles, which from being deposited around an internal magnet must rotate if left free to move. That the earth is hut a shell is not improbable; on the contrary, many philosophers beve maintained that it is so, and with strong erguments in favor of the hypothesis: but I do not wish those who advocate the opinion that it is filled with fire, nor yet those who in preference would have it full of water, to retract their opinions, as the effect will be the same whether there is a free space within, whether fire or a liquid. This being the constitution of our earth, where is the irrationality of supposing that the sun and all the planetary bodies are similarly constituted, and this the cause of their rotation upon their axes. Two of the planetary motions being thus explained, it mey be presumed that magnetism and galvanism will produce the revolution of these worlds in their orbits. It is known that the magnetic fluid is so subtile that it is scarcely impeded by passing through dense solids; e strong magnet will attract a needle placed et the opposite side of a brick wall; the magnetic properties of the sun therefore would not be lost nor diverted from their course in passing through his body, but would effect the galvanic portion of our earth as well as his own surface; that it does influence our earth being presumed, the effect would be that our earth would revolve around the sun. G. F.

GENERAL RULES FOR THE PAINTER.

BY SIR JOSHUA REYNOLDS.

For painting the flesh, black, blue black, white, lake, carmine, *orpiment*, yellow ochre, ultramarine, and varnish.

To lay tha pallette:—first lay carmine and white in different degrees: second, lay *orpiment* and white, ditto: third, lay blne black and white, ditto.

The first sitting, make e mixture on the pallette for expedition ea near the sitter's complexion as you can.

To preserve the colors fresh and clean in painting; it must be done by laying on more colors, and not rubbing them in when they are once laid; and if it can be done, they should be laid just in thair proper places at first, and not be touched again, because the freshness of the colors is tarnished and lost by mixing and jumbling them together; for there are certain colors which destroy each other by the motion of the pencil when mixed to excess; for it may be observed, that not only is the brilliancy, as well as freshness of tints considerably impaired, by indiscriminate mixing and softening; but if colore be too much worked about with the brush, the oil will always rise to the surface, and the performance will turn comparatively yellow in consequence.

Never give the least touch with your pencil until you have present in your mind a perfect idea of your future work.

Paint at the greatest possible distance from your sitter, end place the picture occasionally near to the sitter, or sometimes under him, so as to see both together.

In beautiful faces, keep the whole circumference about the eye in a mezzotinto, as seen in the works of Guido, and the best of Carlo Maratti.

Endeavour to look at the subject, or sitter before you, as if it was a picture; this will in soma degree render it more easy to be copied.

In painting, consider tha object before you, whatever it may be, as made out more by light and shadow, than by lines.

A student should begin his career, by a careful finishing and making out of the parts, as practice will give him freedom and facility of hand; a bold and unfinished manner is generally the habit of old aga.

On Painting a Head.—Let those parts which turn or retire from the eye, be of broken or mixed colors, as being less distinguished, and nearer the borders.

Let all your shadows be of one color; glaze them till they are so.

Use red colore in the shadows of the most delicate complexions, but with discretion.

Contrive to have a screen, with red or yellow color on it, to reflect tha light on the sitter's face.

Avoid the chalk, tha brick dust, and the charcoal, and think of a pearl, and a ripe peach.

Avoid long continued lines in the eyes, and too many sharp onas.

Take care to giva your figures a sweep or sway, with tha ontlines in waves, soft, and almost imperceptible against the back ground.

Never make tha contour too coarse.

Avoid also those outlines and lines which are equal, which make parallels, triangles, &c.

The parts which are nearest to the eye appear most enlightened, deeper shadowed, and better seen.

Keep broad lights and shadows. and also principal lights aud shadows.

Where there is the deepest shadow, it is accompanied by tha brightest light.

Let nothing start ont, or be too strong for its place.

Sqnareness has grandeur; it gives firmness to the forms: a serpentine line, in comparison, appears feeble and tottering.

The younger pupils are better taught by those who are in a small degree advanced in knowledge above themselves; *and from that couse proceeds the peculiar advantage* of studying in ecademies.

Tha painter who knows his profession from principles, may apply them alike to any branch of the art, and succeed in it.

ANSWERS TO QUERIES.

29—*How are the fantoccini figures made and managed?* These figures are common dolls made so that their erms, legs, and heads are in detached pieces, connected together when in use by black silk strings which pass through them, and upwards to the ceiling or some other object, by which they may easily be suspended, the dress, &c. of tha operator for example; every joint is furnished with e smaller and separate fine string, elso black, and sometimes made of horse-hair, or black sewing silk: all these various strings are free to move independent of each other. To exhibit with a figure of this kind, hold the suspending string by your mouth, and by various loops let each string be fastened to ona of yonr fingers, thosa on ona side of the body of the figure to one hand, and the rest to the other hand; any jerk now given to either finger will mova the corresponding joint, and after a very littla practice, a considerable accuracy of motion and time, in dancing, &c. may be attained by the operator.

80—*How is phosphorus mixed with the other ingredients in the making of lucifers?* Make some very strong gum weter, and heat it to a temperature of 104 degrees of Farenheit's thermometer, which will melt the phosphorus, and stirring this up, it will be diffused through tha whole mass of gum water. If then a common brimstone match be dipped in the phosphorized solution, and then suffered to dry it will be one of the Congreve matches.

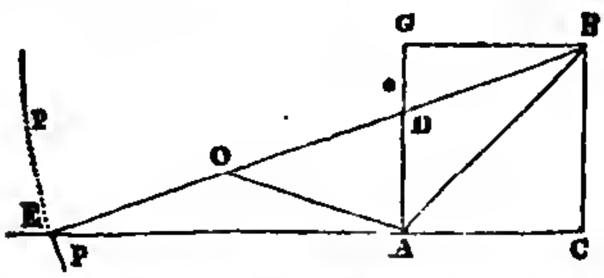
Note.—Care must be taken to hava the proper degree of heat, because phosphorus inflames at 120

94—*How can three different currents of clouds seen at the same time be accounted for?* The motion of clouds along depends on two causes, wind and electricity; when tha latter cause acts, wind is mostly absent, as at tha approach of a thunder storm; this therefore cannot be the cause of the assigned motions, nor either of them; the wind then must give rise to the three currents. That there are such contrarieties of motion in tha atmosphere is evident from daily observation, as well as the direct experience of aeronauts; how it is that clouds lie in strata so as to be susceptible of separate impulses is because of their being differently loaded with moisture, the heavier being nearest the earth, the lighter at the highest region.

99—*Has carburetted hydrogen ever yet been reduced by pressure or cold into a liquid or solid form, &c.?* No, neither this nor any other gaseous compound of hydrogen; they all explode when mixed with oxygen and inflamed.

103—*Is there any woy of trisecting an angle geometricolly?* [*From o French Geometricol Work, by Montuclo.*] Let A B C be tbe proposed angle; bsving raised the perpendicular B C, formed tbe parallelogram B C A G, and produced C A indefinitely, draw the line B D E, so thst the part D E shall be equal to twice the diagonal A B; then the angle D E A is equal to one-third of the angle A B C.

Proof.—Bisect the line D E, and from tbe centre O draw tbe line A O: tbe triangle A O E is isosceles, as is also B A O; consequently the angle O E A is tbe half of tbe angle A B D; and the sum of the two latter being equal to A B C, it is triple of D E A.



The difficulty of this problem seems to consist in forming the line D E, or to fix the point D, and this is not explained. I think, bowever, it may be done thus: take a radius twice A B, and once A G, and describe from the point B a portion of a circle P P, and tben draw tbe required line from B to the point of intersection at C; tben is D E equal to twice the diagonal A B.

Belfast. HIBERNICUS.

106—*Whot is the reason thot o drop of glass, being broken ot the smaller end, flies into dust?* The particles of dropa of glass (by which are understood those long bubbles formed by dropping melted glass in wster,) are from their rapid cooling but little adhesive to each other, and also have, from tbe contraction of them when cooling, a large vacuity within; as soon then as the small end is broken off, the air rushes in with socb force, as to break the sides into atoms.

125—*What is Mr. Roberts's process for preserving animal bodies?* It is supposed to be by the injection into the sorta of a dilute solution of creosote. This will certainly act most powerfully as an antiseptic, if the body be sufficiently imbued with it. In order that this may be the case, and that it may penetrate into the finer ramifications of the blood vessels, the body may be soaked fur an bour or two in hot water previous to its injection: corrosive sublimate is another antiseptic material, and will effectually preserve bodies from putrefaction, but its use is attended with serious disadvantages, as it takes away the colors of all animal matters, making thus the muscles similar in color to the nerves, &c. It also spoils tbe knives used in after dissection.

145—*How are the Protean pictures painted?* Exactly as described under the article "Dioramic Painting," in page 227.

146—*What is the method of making Chinese fire-works?* Answered in page 297.

148—*Whot are the toys colled sensitive leaves, and how mode?* They are made of very thin shavings of horn or ivory, colored and cut into proper form, and may be bought at any toyman's.

153—*How is sheet wax made?* Common white wax, with a smaller or larger portion of tallow, according as the sheets ore wanted for winter or summer use, is melted, and while in this state the requisite color is mixed with it, and being well stirred up, it is poured into a square mould, abont 4 inches long, 3 broad, and 1 deep. When cold, it is to be cut into slices by a clean, smooth, and warm knife, which during the cutting is kept warm and wet, by being, after each slice is cut off, dipped into bot water.

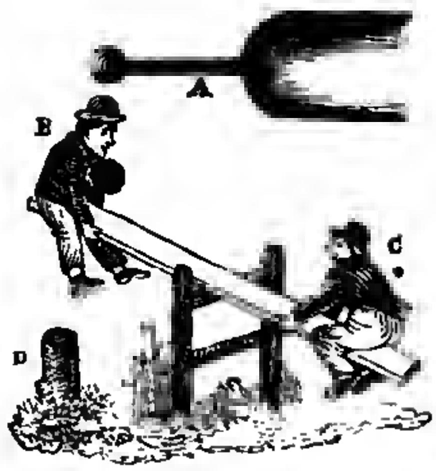
147—*How is lacker for brass and tin-ware mode?* Put into a pint of alcohol an ounce of turmeric powder, 2 drams of arnotto, and 2 drams of saffron; agitate during seven days, and filter into o clean bottle. Now add 3 ounces of clean seed-lac, and agitste the bottle every day for fourteen days. When the lacker is used, the pieces of brass, if large, are to be first warmed, so as to heat the hand, and the varnish is to be applied by a brush; the smaller pieces may he dipped in the varnish, and then drained by bolding tbem for a minute over the bottle. This varnish when applied to rails for desks, &c., has s most beoutiful appearance, being like burnished gold.

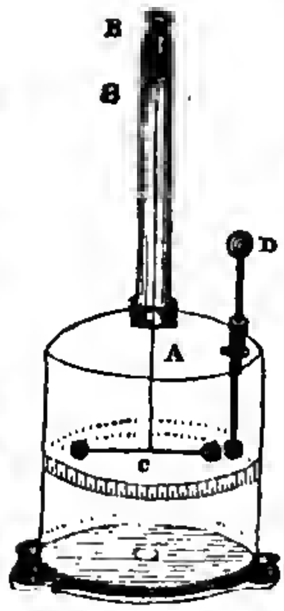
Tin Wore.—Put 3 ounces of seed-lac, 2 drams of the substance known by the name of dragon's blood, (*Sanguis Draconis,*) and 1 ounce of turmeric powder into a pint of well rectified spirits. Let tbe whole remain for fourteen days, but during that time agitate the bottle once a day at least. When properly combined, strain the liquid through muslin. It is brushed over tin-ware which is intended to imitate brass.

MISCELLANIES.

Loss of Weight in Cooking Animol Food.—It is well known tbst, in whatever woy the flesh of animals is prepared for food, a considerable diminution takes place in its weight. As it is a subject both useful and curious in domestic economy, we shall give the results of a set of experiments, which were actually made in s public establishment: they were not undertaken for mere curiosity, but to serve a purpose of practical utility. 28 pieces of beef, weighing 280 lb., lost in boiling 73 lb. 14 oz. Hence the loss of beef in boiling was about 20¼ lb. in 100 lb. 19 pieces of beef, weighing 190 lb., lost in roasting 61 lb. 2 oz. The weight of beef lost in roasting appears to be 32 lb. per 100 lb. 9 pieces of beef, weighing 90 lb., lost in bsking 27 lb. Weight lost by beef in baking is 30 lb. per 100 lb. 27 legs of mutton, weighing 260 lb., lost in boiling, and by having tbe shank-bones taken off, 62 lb. 4 oz. The shank-bones were estimated at 4 oz. each, therefore the loss in boiling was 55 lb. 8 oz. The loss of weight in boiling legs of mutton is 21 lb. per 100 lb. 35 shoulders of mutton, weighing 350 lb., lost in roasting 109 lb. 10 oz. The loss of weight of mutton in roasting was 31⅓ lb. per 100 lb. 16 loins of mutton, weighing 141 lb., lost in roasting 49 lb. 14 oz. Hence loins of mutton lose by roasting about 35½ lb. per 100 lb. 10 necks of mutton, weighing 100 lb., lost in roasting 32 lb. 6 oz. From the foregoing statement, two practical inferences may be drawn. First, In respect of economy, it is more profitable to boil meat than to roast it. Second, whether we roast or boil meat, it loses by cooking, from one-third to one-fifth of its whole weight.—*Philosoph. Magazine.*

2

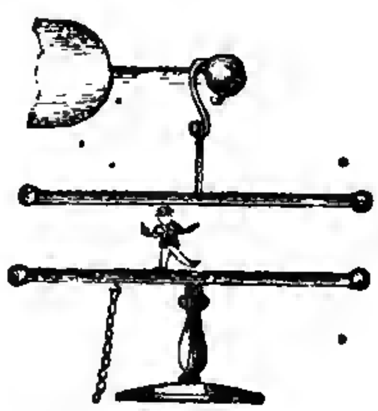




1

ELECTRICAL EXPERIMENTS AND APPARATUS.

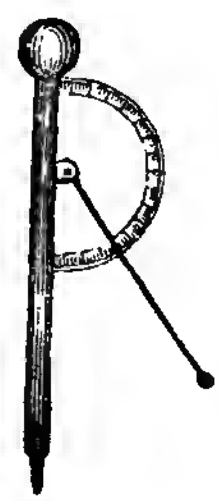
3



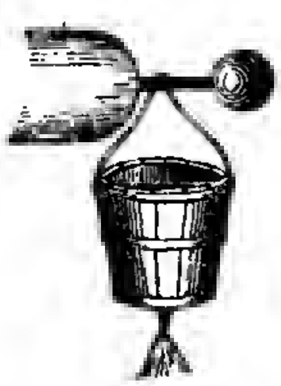
5

7

6



4



ELECTRICITY.

(Resumed from page 179.)

Ex. 49.—*Electric Swing.*—Balance a small figure upon two fine silk strings, and place it within three or four inches of a ball, which forms part of a conductor, while on the other side of the figure is a second ball connected with the ground. Upon putting the machine in action, the figure will vibrate from one to the other.

Fig. 1 represents such an instrument. A is a ball attached to the prime conductor of a machine. B is a ball connected with the ground. C is the figure suspended by silk, and supported by two glass pillars; though these last are not absolutely necessary, because the silk will be sufficient to prevent any charge the figure may receive from being dissipated before it arrives at B, the proper place to deposit it.

Ex. 50.—*The Electric See-saw.*—Suspend a strip, or fine rod of glass upon a centre, and upon each end of it support a light figure of pith. Let one of the figures have no conducting substance under it, nor yet touch the conductor when swinging upwards; but let the other figure come against the ball of the conductor when it rises highest, and touch another ball connected with the ground when descending lowest: if put properly under the conductor of a machine it will vibrate up and down—the opposite figure only acting as a counterpoise to it.

Fig. 2 represents this apparatus. A is the conductor. B the conducting figure. C the counterpoise; and D the part connected with the ground, to carry away the fluid brought down by B.

Ex. 51.—*The Electrical Rope Dancer.*—Suspend from the ball of the conductor two thick wires, about a foot long. The upper wire is connected with the conductor by a small chain, or hook; the lower one hung to this, at the distance of two or three inches, by a silk thread at each end; the lower wire is also connected to the ground by a chain. Place on the lower wire a paper or pith figure, and upon putting the machine in action, it will move alternately and briskly between them.

This experiment is but a modification of the dancing figures, described in page 179. In the cut now given, Fig. 3, the two wires appear unconnected with each other, the lower one having a stand of its own. This is a better form of the apparatus, because when connected together by silk, the figure put to dance is apt to cling to the silk, which destroys the effect intended to be produced.

Ex. 52.—*Electrical Spider.*—Cut out of a bit of cork the body of a spider; furnish it with eight white thread legs, and run through the body a long silk thread. Hold this up in one hand, so that it shall hang two or three inches from the side of the conductor, and hold the finger about the same distance beyond it—when the assistant turns the machine the spider will fly backwards and forwards between the conductor and the finger.

Ex. 53.—*Spinning Sealing Wax.*—Fasten on to a thick wire a piece of sealing wax, about one inch long, by heating it, and thrusting the wire into it. Put the other end of the wire into a hole, either at the end or side of the conductor, so that the wax shall be at some distance off. Underneath where the wax is, either on the table or the floor, place a sheet of brown paper, merely to catch any drops which may fall when the wax is inflamed. Provide yourself also with a lighted candle, and a sheet of white paper. Direct your assistant, (for in this experiment you must have one,) to turn the machine, and stop it exactly at the time you may desire. Then standing near the wax, hold the white paper four or five inches from it, and light the sealing wax. When well lighted, blow it out, and at the same instant let the machine be turned, and exceedingly fine threads of wax will be thrown off, and collected on the white paper, as long as the wax remains melted. Stop the machine—light, and blow out the wax, and turn the machine as before—more of the filaments will be thrown off, and thus any quantity may be collected, and if scraped together by the point of a pin, it will resemble the finest wool, such as cannot be procured by any other means.

Ex. 54. *The—Electrical Pail*, Fig. 4.—Suspend to the ball, which projects from the prime conductor, a small metal or wooden pail, having at the bottom of it a hole, so fine that water will pass only by drops. Pour a little water into it, and when electrified, the water instead of dropping only will pass out in a stream, and thus will divide itself into several streams, each of which in the dark will be beautifully luminous.

This experiment has been supposed to offer an explanation of the fiery rains mentioned in various authors, and is a corroboration of a fact, the utility of which we had once reason to congratulate ourselves upon being acquainted with. The circumstance was as follows:—We were visiting a medical friend, and electrifying a lady for *gutta-serena*, when a gentleman was brought in stunned by a fall from his horse; it was thought advisable to bleed him. The arm was tried; no blood would flow. The temporal artery; still without success. We suggested that electricity should be tried. He was placed on a chair, and that upon an insulating stool, and immediately the machine was put in action, the blood flowed from both orifices, and the gentleman recovered. Might not this fact be of use frequently in our hospitals? It is certainly very seldom, if ever applied to.

Ex. 55.—*Fiery Sponge.*—Suspend in like manner to the bucket a sponge dipped in water, and the luminous streams which issue from it will be more numerous and beautiful than even in the last example.

Ex. 56.—*Electric Planet.*—Suspend from the conductor of a machine a brass ring, about a foot in diameter, and underneath it at about half an inch distance, a metallic plate connected with the ground. Place upon this plate, and within the ring, a very light hollow glass ball—turn the machine, and the little ball will describe an orbit around the ring, and turn at the same time about its own axis. The poles of its rotation are nearly at right angles to the plane of its orbit. We have not tried this experiment. Mr. Adams says, "that it requires considerable attention to make it succeed, as a small difference in the apparatus, or in the force of the machine, &c., will occasion a failure." (See Fig. 5.)

The above, together with the experiments formerly given, are the chief that are had recourse to for amusement. They are all to be explained by the principles of electrical attraction, which important law of the science has given rise to many instruments of paramount utility in pursuing electrical inquiries. The chief of these are known by the name of *Electrometers* and *Electroscopes*, the objects of which is to measure either the quantity or intensity of accumulated electricity. The principal are as follows:—

ELECTROMETERS.

The *Quadrant Electrometer*, (see Fig. 6,) was invented by Mr. Henley. It consists of an upright stem of wood or metal, terminated by a ball at the top, and bearing an arc of ivory, divided into degrees, as in a great circle: that is, containing 90 degrees in every quarter, beginning at the bottom with zero, and having 90 at an equal distance from the upper and the lower part of the semicircle of ivory. In the centre of this is balanced a very thin rod of wood, with a pith ball at its outward point, as represented. The slender rod is capable of motion up and down. It is used in connection with a charged jar or battery, and by the pith ball and its stem rising to a certain height, it indicates the intensity of the charge within the bottle or battery. At the greatest charge of a Leyden jar it will rise to nearly 90 degrees, but in a battery seldom more than 60 or 70. It being impossible to charge a battery so highly as a single jar.

Saussure's Bottle Electrometer is represented in Fig. 7. It consists of a glass case or bottle, with a metal bottom, four pieces of tinfoil being pasted on the sides of the glass, in connection with the bottom; withinside the glass are two very fine silver wires, swinging freely in a loop above, and ending below in two small pith balls. The upper part of the instrument is a brass cap, terminated by a ball and a rod of three or four feet, made in joints for the sake of greater convenience, and pointed. This instrument when used is to be placed in some exposed situation, when an approaching storm or other cause indicates the electric fluid in the atmosphere to be disturbed. The silver threads by their divergence will show the degree and character of the fluid in contact with the instrument. When it is used in rainy weather, the upper part of the glass is covered with a hood, like an umbrella, to keep the glass dry, and consequently the electrometer insulated. Such a hood is represented upon it in the figure given.

In the above electrometers, as well as in the Gold-leaf Electrometer, described in a former part, it will be seen, that however valuable they may be as indicating an extremely minute quantity of the electric fluid, yet for comparative and delicate experiments they all fail; because gravitation considerably influences the weight of the moveable parts at different altitudes. To remedy this inconvenience, Mr. Coulomb contrived his Tortion Electrometer, which is represented in Fig. 8. It consists of a fine metallic wire A, one end of which is attached to the screw B, and to the other is suspended the horizontal needle C, composed of gum lac, or other non-conductor, and armed at one extremity with a gilt pith ball, counterpoised at the other end by an index. The conductor D is a small wire, with a ball at each end, passing through the glass receiver, in which the needle is suspended, and having its lower ball, opposed to that of the needle. By the screw E the two balls are brought into contact, and the index then points to zero, or the divided scale of degrees. On communicating a very feeble electrical power to the conductor, it transfers it to the moveable pith ball, and repels it a certain number of degrees, proportional to the intensity of the acquired electricity, and measured by the power of tortion which it exerts upon the fine wire. By experiments made with this electrometer, it would appear that the electrical powers follow the law of gravitation, in being *in the inverse ratio of the squares of the distances of the acting bodies.* In the most delicate construction of the instrument, a single silk-worm's thread is used instead of the wires.

METHOD OF DISSECTING SEEDS.

The great rule is to throw all seeds, even the most recent, into warm water, and first of all to free those of their integuments, which have hard ones, and such as deny a free access to water. When the seeds have been somewhat softened, one of them is to be taken out of the water, and first divided into two equal parts by a transverse section, made from the belly to the back, and the divided portions are to be again instantly thrown into water, that the plane of the section may freely imbibe it. Afterwards this softened plane is to be examined by a lens of moderate magnifying power, by which means a threefold difference is generally detected: for first, the plane is manifestly divided, from one wall of the seed to the other, by a simple transverse chink containing no matter of a different color within it: or secondly, the plane is marked with a smaller transverse chink, or a roundish areola, in both which a foreign or different colored matter appears, and in this case the seed is safely pronounced to be albuminous, and to contain an embryo longer than half the albumen: or thirdly, no vestige whatever of a chink or areola can be detected, but the plane appears every where uniform and homogeneous; and then we may be very certain that either a very large false-monocotyledonous embryo constitutes the whole nucleus of the seed, as in paullinia; or that a minute embryo must remain somewhere in the albumen and either in the superior or inferior segment of the divided seed. In this last case, which is by far the most frequent, a new section is to be made in another seed; which will divide it according to its axis into two equal parts. The segments being again thrown into water, are to be treated in the same manner exactly, as the transverse segments; by this means the embryo, unless it be extremely minute, may easily be detected in one of the extremities, or the back of the seed, either in the form of a more or less short cylinder, or of a snowy or green globule; and, if the section be rightly made, it sometimes falls spontaneously out of its cavity, and sinks to the bottom of the water. This very simple process is alone sufficient to detect, and afterwards entirely denude the embryo, in by far the greatest number of seeds: but when a seed occurs, possessing a cartilaginous albumen, and a very minute embryo, as in *asarum*, then the examination is to be conducted in a different manner. In this case, at that extremity of the seed, where we suspect the embryo to be situated, thin plates are to be repeatedly and carefully cut away from the dorsal and ventral parts of the albumen, till only the middle very thin plate remains, which is then to be put into water, or oil of turpentine, till it becomes pellucid like glass. By these means unless the seed be barren, which indeed often happens, the embryo will be detected by a good lens, of the form of a snowy medullary point, which, from its whiteness, is not easily distinguished from the albumen. It is not easy to describe in what manner very minute embryos of this kind are to be freed from their albumen, that they may be farther examined by themselves: it is to be left to the dexterity of each person.

But whether we are desirous of examining seeds, with a view to scrutinize the albumen and embryo, or on any other account, we ought always to remember that they should be thrown into water, and detained there some time, however fresh they are; for, without this preparation, it can never be learnt, for example, whether they are gelatinous or not; because this quality, even in the most recent dry seed, cannot be detected by the eye; and it can never be known in old seeds, whether they have been berried or not, because the fleshy pellicle except in moistened seeds cannot be properly distinguished: not to say any thing of the greater tractability of the moistened albumen, and of the less degree of brittleness of the softened embryo.

OIL PAINTING.

(Resumed from page 294.)

To heighten a color it should be mixed with any similar color of a lighter tone, as light red upon dark red; yellow upon light red; white upon yellow, &c.

Though it be absolutely necessary in many cases to mix two or more colors together to produce a desired tint, yet the student must be cautioned against too wantonly indulging himself in the mixing of colors, for it is an undoubted fact, that the more simply the colors are used the easier they work, their appearance is brighter, and they are far more durable than a compound color. *The following cautions should be carefully attended to by the student:*—If a tint be required while he is at work on a picture different from any on his palette, it is better to mingle the colors which compose it with a knife than with a pencil, as the latter always retains more of one color that another, when it is used to incorporate them together.

One pencil should always be kept to one color, otherwise the colors will never appear fresh.

Colors should never be teased, that is, mixed too much, or when, instead of being laid on the canvas at once, they are too much worked about with the pencil.

A proper allowance must always be made for that gloss and brilliancy which oil colors possess when wet.

The decay of colors is in a great measure the consequence of too great a quantity of oil; the parts of a picture which first begin to fade are the darker colors, the glazing, and where the color is thin, but the lights stand much longer.

It is always proper to permit a first coat of color to be sufficiently dry before a second is applied.

To ascertain when an oil painting is dry, it must be breathed upon pretty strongly, and if it take the breath it is dry.

The palette and pencils when laid by should be constantly cleaned with spirits or oil of turpentine.

PORTRAIT PAINTING.

Process.—With regard to the progress of a picture, no rule can be given that will universally serve to direct the student: scarcely any two masters observe the same mode of procedure, the judgment is the principal guide, and however two artists may vary from each other in the order of performing their work, they in the end produce the same effect as if they had both strictly followed one determinate rule. The process of oil painting, particularly the coloring of flesh, is to be divided into three stages, or paintings.

The colors and tints necessary for the first and second stages of painting the flesh are:—1. Flake white. 2. Light ochre and its tints. 3. Light red and its two tints. 4. Vermillion, and its tint. 5. A tint composed of lake, vermillion, and white. 6. Blue tint. 7. Lead tint. 8. Half shade tint, made of Indian red and white. 9. Shade tint. 10. Red shade. 11. Warm shade.

The finishing palatte for a complexion requires five more: viz., 1. Carmine and its tint. 2. Lake. 3. Brown pink. 4. Ivory black. 5. Prussian blue.

FIRST STAGE, OR DEAD COLORING OF FLESH.

Having first faintly sketched the outline of the figure with white chalk, and afterwards formed it more correctly with the pencil and any of the transparent colors, you proceed as follows:—

The first layer of colors consists of two parts; the one is the work of the shadows only, and the other that of the lights. The work of the shadows is to make out all the drawing very correctly with the shade tint, and to remember to drive or lay the color sparingly. The lights should be all laid in with the light red tint, in different degrees, as we see them in nature. These two colors united produce a clean tender middle tint. In uniting the lights and shades you should use a long softener, about the size of a large swan quill, which will help to bring the work into character; then go over the darkest shadows with the red or warm shade, which will finish the first layer.

The warm shade being laid on, the shade tint improves it to a warmer hue, but if laid instead on the shade tints it will dirty and spoil the colors it mixes with, and if the red shade is laid first instead of the shade tint, the shadows would then appear too red. In order to finish the first painting, improve the reds and yellows to the complexion, and after them the blues, observing that the blues on the reds make the purples, and on the yellows produce the greens. The grounds of shadows in what is called the dead coloring, should be such as will support the character of the finishing colors, which ground must be clean and a little lighter than the finishing colors, because the finishing of the shadows is glazing.

If you begin the first painting with glazing, it will stare and be of no use, and the solid colors which are laid on it will look heavy and dull. Remember to leave no roughness, that is, none such as will appear rough, and interrupt or hurt the character of the finishing colors, which by examining the work while it is wet with a soft tool, or when it is dry with a knife, may be avoided, as it will easily take off the knots and rougher parts.

The light red and white improved is superior to all others colors, for the first lay or ground, which should always be done with a full pencil of a stiff color, made brighter than the light, because it will sink a little in drying. The great masters very seldom softened or sweetened the colors, but in uniting the first together, were very careful in preserving the brightness of their colors, and therefore did not work them below the complexion; for to force or keep up a brilliancy in the ground can only be done with the whites, reds, and yellows, which method will make up for the deficiency of the white grounds, therefore the first painting should be left bright and bold, and the less the colors are broken the better.

(Continued on page 342.)

LIME CEMENT.

There are two modes in which lime acts as a cement; in its combination with water, and in its combination with carbonic acid.

When quick lime is rapidly made into a paste with water, it soon loses its softness, and the water and the lime form together a solid coherent mass, which consists, as has been stated before, of 17 parts of water to 55 parts of lime. When hydrate of lime whilst it is consolidating is mixed with red oxide of iron, alumina, silica, the mixture becomes harder and more coherent than when lime alone is used; and it appears that this is owing to a certain degree of chemical attraction between hydrate of lime and these bodies and they render it less liable to decompose by the action of the carbonic acid in the air, and less soluble in water.

The basis of all cements that are used for works which are to be covered with water must be formed from hydrate of lime; and the lime made from impure limestones answers this purpose very well. Puzzolana is composed principally of silica, alumina, and oxide of iron; and it is used mixed with lime to form cements intended to be employed under water. Mr. Smeaton, in the construction of the Eddystone light-house, used a cement composed of equal parts by weight of slacked lime and puzzolana. Puzzolana is a decomposed lava. Tarras, which was formerly imported in considerable quantities from Holland, is a mere decomposed basalt: two parts of slacked lime and one part of tarras, forms the principal part of the mortar used in the great dykes of Holland. Substances which will answer all the ends of puzzolana and tarras are abundant in the British Islands. An excellent red tarras may be procured in any quantities from the Giant's Causeway in the north of Ireland: and decomposing basalt is abundant in many parts of Scotland, and in the northern districts of England in which coal is found.

Parker's cement, and cements of the same kind made at the alum works of Lord Dundas and Lord Mulgrave, are mixtures of calcined ferruginous, siliceous, and aluminous matter, with hydrate of lime.

The cements which act by combining with carbonic acid, or the common mortars, are made by mixing together slacked lime and sand. These mortars, at first solidify as hydrates, and are slowly converted into carbonate of lime by the action of the carbonic acid of the air. Mr. Tennant found that a mortar of this kind in three years and a quarter had regained 63 per cent. of the quantity of carbonic acid gas which constitutes the definite proportion in carbonate of lime. The rubbish of mortar from houses owes its power to benefit lands principally to the carbonate of lime it contains, and the sand in it; and its state of cohesion renders it particularly fitted to improve clayey soils.

The Romans, according to Pliny, made their best mortar a year before it was used; so that it was partially combined with carbonic acid gas before it was employed.

In burning lime there are some particular precautions required for the different kinds of limestones. In general, one bushel of coal is sufficient to make four or five bushels of lime. The magnesian limestone requires less fuel than the common limestone. In all cases in which a limestone containing much aluminous or siliceous earth is burnt, great care should be taken to prevent the fire from becoming too intense; for such lime easily vitrifies, in consequence of the affinity of lime for silica and alumina. And as in some places there are no other limestones than such as contain other earths, it is important to attend to this circumstance. A moderately good lime may be made at a low red heat; but it will melt into a glass at a white heat. In lime-kilns for burning such lime, there should be always a damper.

In general, when limestones are not magnesian, their purity will be indicated by their loss of weight in burning; the more they lose, the larger is the quantity of calcareous matter they contain. The magnesian limestones contain more carbonic acid than the common limestones; and all lose more than half their weight by calcination.

EASY METHOD OF MAKING BAROMETERS.

An accurate barometer is essential in gaseous investigations; but as boiling the mercury in the tube is rather hazardous, and the fitting it on an air-pump, a work of time and attention; such an instrument is troublesome to make, or expensive to purchase. Advantage may, however, be taken of the vacuum produced in the barometer itself, and a correct instrument thus placed within the reach of every practical chemist. The detail may be as follows:—

Provide 1. A clean barometer tube, not less than $\frac{1}{3}$ inch bore at the closed end, but which may run away to $\frac{1}{8}$th at the lower end, to save mercury, and not less than 33 inches long.

A tube 8 or 9 inches long, $\frac{1}{4}$ or $\frac{3}{8}$ bore, open at both ends, one being drawn out to a fine aperture; for pouring in the mercury.

3. Four or five pounds of mercury, (8 or 10 lbs. would be more convenient) which has been standing three or four weeks under weak nitric acid, (1 acid to 10 water); or distilled mercury if to be had.

4. An iron ladle, and a disc of sheet iron which will not quite cover the mercury, when in the ladle.

5. A small Wedgewood mortar, which the mercury will $\frac{1}{3}$ or $\frac{1}{2}$ fill.

6. A turned wood box and lid, (such as are used for tooth powder), not less then $1\frac{1}{4}$ inch internal diameter and depth; which must have a hole through the lid large enough to slide up and down the tube, and be varnished inside and out, for the cistern.

The tube should be dried over a lamp or before a fire, with the open end up, and covered with a bit of muslin to keep out dust. In the mean while the mercury may be placed in the ladle, with the iron disc floating upon it; and set on the fire till it boils, when it is to be instantly removed and placed in the cold. Whilst it is cooling, a horse hair must be passed quite down the tube to the closed end, or if one is not long enough, two may be bound together with a fibre of silk. A knot makes a difficulty in passing them down. A fine silken thread, waxed to give it stiffness will do, but the tube must then be cold first. Wire does not answer, the tubes being very subject to snap after it, even when silked.

As soon as the mercury is cold enough to handle, it is to be poured into the Wedgewood mortar, and the pouring tube having its point dipped below the surface to exclude the dust, is to be filled to about

an inch by suction applied at the other end. This quantity will remain in, if the tube is held at but slight declivity. The wide end being now closed with the finger, the pouring tube is to be removed to the barometer tube, which should be held mouth up, at an inclination of about 45°. The point of the pouring tube being entered into the mouth, the finger is to be withdrawn, and the mercury poured in, by increasing the declivity of the pouring tube. Thus the mercury runs down to the closed end, and the air passed up by the horse hair, leaving few or no bubbles. When it contains three inches of mercury, however, it should be carefully examined all round, and if any bubbles appear, they should be brought to the hair, by gently tapping the tube, held almost horizontal with a bit of wood, at the same time turning it slowly a little backward and forward upon its axis, the hair being never allowed to go below. This should be done at three or four inches, to have a smooth column of mercury as the filling proceeds. When the tube is thus full, the hair is to be withdrawn, leaving an end of it in the vacancy left by its removal, until that also is filled. The hair being now withdrawn altogether, the tube is to be overfilled, so that the mercury presents a convex face above the glass.

The open end is now to be stopped with a finger, just moistened to give it closeness; which squeezing out the superfluous mercury will effectually prevent all access of air. The tube is now to be inserted in the mortar of quicksilver, and brought to a vertical position, when a vacuum will be produced by the descent of the mercury.

The lower end is now to be again tightly closed with the finger, the tube lifted out of the mortar and brought gently to a horizontal position. The finger must be kept tight against the open end, to maintain the vacuum; when a minute portion of air will make a visible bubble in any part of the column. By lowering the head a very little, the mercury may be made to flow gently to that end, and leave the vacuum next to the finger. By a short jerking motion in the direction of its length, the tube and mercury are kept in a sort of vibration, the mercury striking smartly against the closed end, like the water hammer, and this vibration brings together and carries upward toward the finger, any bubbles which may be present in the column. A very slight inclination is sufficient for this purpose, and of course, any increase thereof tends to diminish the lowest bubbles by compression: but a little change from less to greater, and *vice versa*, puts in motion the stationary ones, when there are such. If the tube is not clean, little bubbles will fix themselves to any dusty part, and cannot sometimes be moved unless by washing them away: pouring the mercury gently from the head of the tube to the finger, and back again three or four times.

When the mercury lies smooth for its whole length, the finger is to be withdrawn, the hair put in and three or four inches vacant carefully refilled. The tube is then to be stopped and inverted in the quicksilver with the same precautions as before, against the entry of a bubble under the finger. When brought to the perpendicular position, it should be turned round and examined on all sides to see that the column is perfectly smooth and bright; and when quickly inclined, so as to allow the mercury to reach the head, it should return a smart rap. If both these conditions are found, the tube is well filled; but as a repetition of the levelling and vibratory process for drawing off the bubbles, is a work but of little time and trouble, it is better performed a second time for the sake of security.

The tube thus twice purified from air, and replaced in the mortar of quicksilver, wants only its cistern. The lid is first to be plunged beneath the surface, and there slid up over the tube, say three or four inches where it is to be fixed by a slight wedge, or slip of paper. The box is next to be filled, plunged also under the quicksilver, and its edge passed under the tube, which must rest in it, not quite upright, so that it may be full to the head. The box and tube, in this position, both full of mercury, are to be taken out of the mortar and set on a saucer or plate; when the tube being brought upright mercury will descend, and flow over the sides of the box; more is also to be withdrawn from the box, by suction with the pouring tube, until about ¾ of an inch deep is left above the bottom of the tube: a little more or less, according to the state of the barometer, at the time; above or below the average; but if below, the average can be attained by inclining the tube.

A slip of wood, say ¼ of an inch square, but cut away at each end to an edge, and *exactly* 29½ inches long, must now be placed in contact with the surface of mercury in the cistern, and a mark made on the tube at its upper end: a scratch is sometimes hazardous; a little paint on a camel's hair pencil is safer. The lid is now to be slipped down on the box, and the whole removed from the plate, on to a piece of thin chamois leather; which being brought up over the box, is to be tied tight round the tube; and it may then be set on the case, the box being supported beneath to the proper height. If the barometer stood at 29½, or being below, was brought to that height by declination, the mark is a standard; if above, it must be corrected for the depression of the surface in the cistern. The scale must also be corrected, for the counter-elevation and depression in the cistern; which is conveniently ascertained by previously filling three inches of the tube, and measuring the height it occupies in the box with the tube immersed; allowance being made for its conical form, if it be such. But this may be done by different methods, generally known.

Such an instrument may be prepared by any practical chemist, and may be trusted for common laboratory purposes. For investigations of extreme delicacy, of course, every possible precaution and perfection are required.

REVIEW.

Manchester as it is; or Notices of the Institutions, Manufactures, Commerce, Railways, &c., of the Metropolis of Manufactures; interspersed with much valuable information, useful for the resident or stranger, with numerous Steel Engravings and Map. Orr and Co., London, 1839.

Such is the title of an admirable guide-book to this great mart of industry, and mint of wealth. Every thing relating to a town like this is of more than local interest; and upon the getting up of this little work, there has evidently been more than usual care bestowed and expense incurred. The plates are numerous and good; the matter varied; accurately, and carefully written; the printing and

paper good, and the whole cheap. We have been especially delighted at learning the commercial habits, literary pursuits, and political opinions of the diversified inhabitants. Of these portions of the book, we, however, dare not quote, they not being scientific; but the following, though by no means the best written, we hope will be of interest to our readers:—

Geology of Manchester.—"The rocks exhibited round Manchester belong to the saliferous and carboniferous groups, the strata exposed being the
Upper New Red Sandstone,
Magnesian Limestone,
Lower New Red Sandstone, or *Rothe Todte Liegende*,
Upper Coal Measures.

The extensive range of new red sandstone spreading over the rich lowlands of Cheshire, has its northeastern terminus here. Near Medlock-bridge, Higher Ardwick, it rests unconformably upon the coal strata. Near the Vauxhall-gardens, St. George's road, it is found covering the magnesian limestone. The magnesian limestone which, in the north of England, is several hundred feet in thickness, is here very limited, chiefly consisting of clays or marls. The true limestone is in several beds of a few inches thick, which, as well as the intervening clays, contain remains of aviculæ, axinæ, &c., fossils characteristic of the same formation in Yorkshire. Below this is the rothe todte liegende, which is well exhibited at the Vauxhall delph, where it may be seen resting unconformably upon the coal measures. It is here very unlike the same formation in Durham, bearing a more close resemblance to the new red sandstone, and contains none of the coal plants found at the above locality.

"The most interesting deposits exhibited near Manchester are certainly the upper coal measures, as seen at the Ardwick limestone works, and at the weir on the river Medlock, near Pinmill-brow. At the former localities three beds of limestone are worked; they form nearly the top of the carboniferous series, being more than any other coal strata in the neighbourhood. Their connection with the coals of Clayton and Bradford may be traced by following the banks of the river towards the canal aqueduct. The limestones are supposed by some to have been formed in fresh water, but this is doubtful.

"On the opposite side of the town, a fine example of a fault or dislocation occurs; it runs along the valley of the Irwell, and disappears amongst the hills above Bolton. Its vertical extent is unknown, but is probably not less than seven hundred feet. At the collieries of Mr. Fitzgerald, near Pendleton, the upper coals (corresponding in some degree with those at Bradford) are met with, and continue to the celebrated Worsley collieries, where they also form the top of the series. As we approach the range of hills seen near Oldham, Rochdale, Bury, Bolton, and Chorley, the coals and rocks of the lower parts of the series exhibit themselves.

"The different beds in connection with the coal-seams contain many of the characteristic fossils of the carboniferous group: remains of fish have been found with most of the coals, whilst extinct and tropical forms of plants are in many places extremely abundant. The fish chiefly belong to the Sauroid and Lepidoid families of M. Agassi. The plants are ferns, fruits, gigantic reeds, and arborescent forms of cryptogamous plants, as well as many others of doubtful affinities."

The Coal Field of Lancashire.—"It has been calculated that the available coal beds of Lancashire amount in weight to the enormous sum of 8,400,000,000 tons. The total annual consumption of this coal, it has been estimated amounts to 3,400,130 tons. Hence it is inferred that the coal field of Lancashire, at the present rate of consumption, will last 2,470 years.

"The coal strata have never been found, except lying between the magnesian limestone and the millstone: the former crops out at Ardwick, on the south-east, and the coal stratum commences in the adjoining township of Bradford. Taking the line of the Rochdale canal as a guide, the various coal strata crop out one after another, until in the neighbourhood of Littleborough, the last valuable seam, appropriately called the 'Mountain Mine,' is discovered. Under this there is no mine of value. Taking the direction to the right or left, the same facts present themselves—towards Oldham, Bolton, Bury, Ashton, and indeed round the whole circumference of Manchester. Beyond this boundary there is another extensive field in the Wigan district: so that Manchester has, in her own immediate vicinity, a copious supply of coal from the mines of Pendleton, Pendlebury, Worsley, Ashton, Dukenfield, Oldham, Rochdale, Middleton, Radcliffe, Tonge, Great and Little Lever, Darcy Lever, Hulton, &c.; and travelling beyond this circle of about ten miles there is the second or Wigan coal district, embracing the districts of Hindley, Abram, Leigh, &c. Somewhat more out of the line, there are the Haydock, Huyton, Pemberton, St. Helens', and other collieries; but the facilities of conveyance being greater towards Liverpool than towards Manchester, the produce of those mines goes almost wholly to supply the former town. Wigan is the ultimate point from which coal are now sent to Manchester. The weekly consumption of Manchester and neighbourhood is estimated at about 26,000 tons; and it is believed that of this quantity only about a thousand tons are derived from the Wigan district. Until within the last three or four years, when the trade was encouraged by a reduction of about one shilling in the ton on the Duke of Bridgewater's canal, no coal whatever came from that quarter, but as the mines more immediately contiguous to Manchester begin to fail, the remoter places will of course come to aid the market. At present, Bolton and Oldham supply the great bulk of coal: it is stated that forty boats, each containing twenty tons, are employed by one colliery alone in that district. Pendleton, in point of situation, has the superiority over other collieries, inasmuch as the mines are within two miles of the centre of the town. Other coal-owners, however, are compelled to lower their prices to meet this advantage. At present, from 7s. 6d. to 8s. per ton is the rate at which coal is laid down at the engine-houses of factories, whilst for private consumption it is charged as high as 12s. the ton. In 1831, engine coal obtained 10s. per ton, but the opening of new or the extension of old collieries at Pendleton, near Rochdale, and at Worsley, brought down the price to 6s., and since that time it has gradually recovered."

Preservation of Ships from Worms.—The French have made a discovery which is likely to have considerable effect in reducing the expense of constructing vessels. Mix pitch and tar with essence of tobacco, and use this mixture to caulk the ships; by it they are preserved from worms, which the tar, thus prepared, poisons.—*Times.*

Learned Societies of London.

		SECRETARY.	Ann. Sub. £	s.	Entrance £	s.	TIME OF MEETING.	LENGTH OF SESSION.
British Association ...	Wondering..........	R.I. Murchison, F.R S.	1	1	..		Once each year	Several Days
Royal Society	Somerset House	P. M. Roget, M D. ..	4	0	10	0	Weekly, Thurs., ½-p. 8. p m.	Nov. to July.
Society of Antiquaries	" "	N. Carlisle, F. R S. ..	1	4	8	8	" 8 "	
Statistical Society	Trafalgar Square....	W. Greig, F.R S. ...	3	3	6	6	" Monday, 8 p.m. ..	
Royal Astronomical Soc	Somerset House	C. Bishop, Esq	2	2	2		Monthly, Friday, " ..	
Linnæan Society	Soho Square	E. Boott, M.D.	3	0	6		Fortnightly, Tuesd., 8 p.m.	
Botanical Society......	20, Bedford Street	G. Geddes, Esq.	1	1	1		Fortnightly, at 8 o'clock ..	
Microscopical Society	21, Regent Street....	J. Farr, M D.		1	1	1	Last Wed., each month, at 8.	
Royal Institution	21, Albemarle Street.	E. R. Daniell, F.R.S	.		..		Weekly, Friday, ½-p. 8 p m.	Jan. to June.
Inst. of British Architects	6, Low. Grosvenor St	T. L. Donaldson, Esq.	3	3	5	5	Fortnightly, Monday, 8 "	Dec. to July
" Civil Engineers	, Cannon Row, West	T. Webster, Esq.					Weekly, Tuesday, 8 p m. ..	Jan. to July.
Zoological Society	28, Leicester Square.	Rev. J. Barber					Fortnightly, Tues ½-p. 8 p.m	Nov. to July.
Royal Soc. of Literature	St. Martin's Place ..	Rev. R. Cattermole.					" Thurs., 4 p.m. ..	
Horticultural Society ..	21, Regent Street....	Professor Lindley ..		4	6	6	Irregular, Tuesday, 3 "	
Entomological Society	17, Old Bond Street..	J.O. Westwood, Esq...	.		..		1st Mon. in each month, at 8	
Royal Medical Society.	Berners Street ..	J. Glendinning, M D.		3	6	6	Fortnightly, Tu., ½-p. 8 p.m.	Nov. to May.
Society of Arts........	Adelphi	W. A. Graham, Esq.		2	..		Weekly, Wednes., ½-p 7	Nov. to July.
Geological Society	Somerset House ..	J. W. Hamilton, Esq					Fortnightly, Wed., ½-p "	"
London Institution ..	Finsbury Circus	W. Tite, Esq.					Occasionally............	Library open during the year.
Medico-Botanical......	32, Sackville Street..	G. G. Sigmond, M. D.						Nov. to July.
Numismatic	Somerset House	....					Monthly, Thursday, 7 p.m.	
Ornithological Society	50, Pall Mall........	....					" Friday, 3 "	
Royal Asiatic	15, Grafton Street ..	Capt. H. Harkness ..					Fortnightly, Satur., 2 "	
Royal Geographical ..	21, Regent Street....	Capt. Washington, R N					" Mon., 9 "	

☞ Most of the above Societies publish their Transactions, and have Libraries and Museums open, at stated periods, to the members. The admittance to them is by being nominated by one or more members, and afterwards balloted for.

Metropolitan Literary, Scientific, and Mechanics' Institutions.

ADVANTAGES:—Library, Reading, and News Rooms. Lectures and Classes on Science, the Fine Arts, General Literature, Languages, &c.

		SECRETARY.	TERMS. £	s.		
†*London Mechanics'	23, Southampton Building	A. Macfarlane, Esq.	0	6 ⅌ Q.	Wed & Friday ½-p. 8 p	
*City of London L. & S.	Aldersgate Street	G. Stacy, Esq	2	2 Ann.	Wednes. 8 p m	
*City of Westminster L S &M	5, Little Smith Street ...	G. Trace, Esq	0	6 ⅌ Q.	Thurs ½ p 8.	
*Metropolitan L. & S.	Bishopsgate Street	....	1	10 Ann.	" 8 "	
†*Southwark Literary Society	36, Bridge House Place .	C. Gannes, Esq. ..	1	10	Wednes 8 "	
*Mary-le-bone L. & S	Edward St., Portman Sq	— Hall, Esq.......	2	2	Mon. ½ p 8 "	Discuss. on Tuesday.
*Camden Town L & S.	Pratt Street	W.J E Wilson, Esq	1		Thursday, 8 "	
*Hammersmith L. S. & M. ..	High Street	J P. Le Maitre, Esq	1	0	Friday, 8 p.m.	
†Eastern L. & S. Institution.	Hackney Road	J. Pitman, Esq.....	1	1	Tuesday, 8 "	
Eastern L. & S. Institution.	Commercial Road		1	1		
†Greenwich Society	5, Nelson Street		0	10		Lectures o[illegible]nally
*Western L & S.	7, Leicester Squ	T. Snelson, Esq. ..	2	2	Thu ½ p 8 p.m.	
*Poplar Institution	67, High Street	T. E Bowkett, Esq	0	5 ⅌ Q	Tuesday, 8	Discussion on Friday
Tower Street Mutual Ins. ..	16, Great Tower Street		0	1 "	Mon ½-p 8 "	Discussion on Wed.
Woolwich Institution		W. Cocks, Esq .	0	3 "	Mon ½-p 7 "	Lect. once a fortnight
Croydon L. & S.	High Street		0	2 6d.	Tuesday 8 "	Lect. alternate weeks.
Deptford	High Street		0	2 6d.		
Finsbury Mutual Instruction	South Pl Chapel, Finsbury		0	1 6d.	Weekly	Dis. alternate Tuesds
Hampstead L. & S.			2	2	Weekly	
*Highgate L. & S. .			1	1	Fortnightly ..	
*Islington L. & S.				2	Thurs, 8 p m	Museum attached.
Sloane Street L. & S.	30, Sloane Street		2	2	Tuesday "	Conver. every fortnight
Peckham L. & S.			2	2	Weekly	
†Philosophical Institution ..	Beaumont Sq., Mile End..	. Hemans, Esq. ..	1	0	Sunday	Museum attached.
*Richmond L. & S.			1	1	Tuesday, 8 p m.	Conversazione.
*Royal Kensington L. & S. ..	Lower Phillimore Place	. White, Esq.			Weekly	Conversazione.

☞ Those marked † admit Strangers to the Lectures at One Shilling each time. Those marked * admit Ladies and Youths at a less price.

Buildings, &c. Open to the Public Gratuitously.

*Those marked * require a Member's Ticket for Introduction.*

British Museum, Bloomsbury—Mondays, Wednesdays, Fridays, from 10 till 4. May to Sep. 10 to 7. Closed the first week in January, May, and September.

National Gallery, Trafalgar Square—Mondays, Tuesdays, Wednesdays, Thursdays, from 10 to 5. Closed for six weeks from the second week in September.

St. Paul's—Each week day, from 9 to 11, and 3 to 4.

*East India Museum, Leadenhall Street—Saturday, 11 to 3 All the year, except September.

*Saull's Geological Museum, Aldersgate Street—Thursday, 11 to 1.

*Smith's Museum of Roman Antiquities, 47, Lothbury—Daily, at 11.

*Soane Museum, Lincoln's-Inn Fields—Thursdays and Fridays, in April, May, and June, 10 to 4. Tickets to be had by sending a Letter ⅌ post.

*College of Surgeon's Museum, Lincoln's-Inn Fields—Wednesdays and Fridays.

*Society of Arts, Adelphi—Any day, except Wednesday.

Hampton Court Palace—Every day, but Friday, from 10 till 5; and on Sundays after 2.

Kew Gardens, Kew Green—Plantations open on Sundays and Thursdays. Botanical Gardens every day after 1

Model Room, Woolwich—Daily, during Daylight

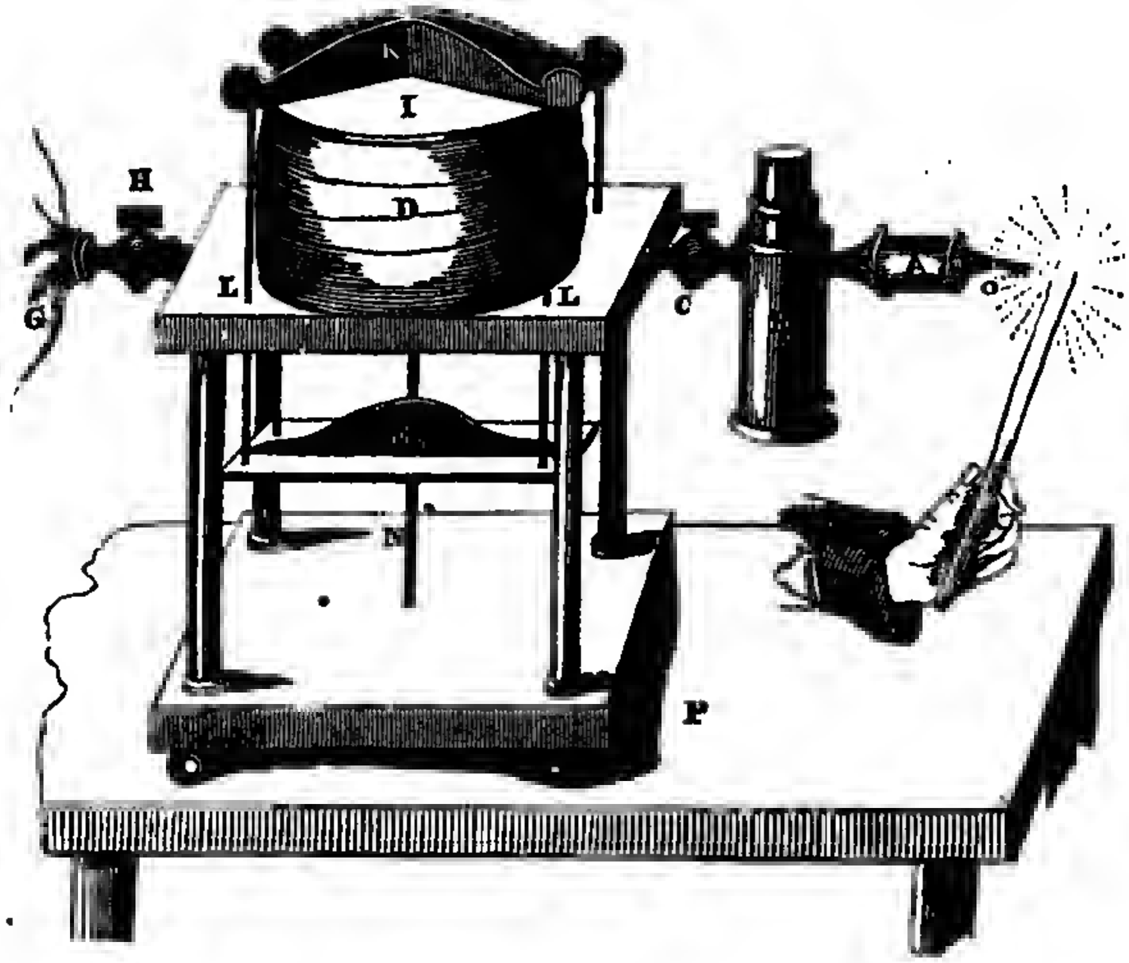
Dulwich Gallery—Week days, except Friday, 10 to 5 in summer, to 3 in winter. Children not admitted. Tickets to be had of any respectable Printseller.

The Armouries of the Tower may be seen daily, from 10 till 4, at Sixpence each Person. Regalia, Sixpence.

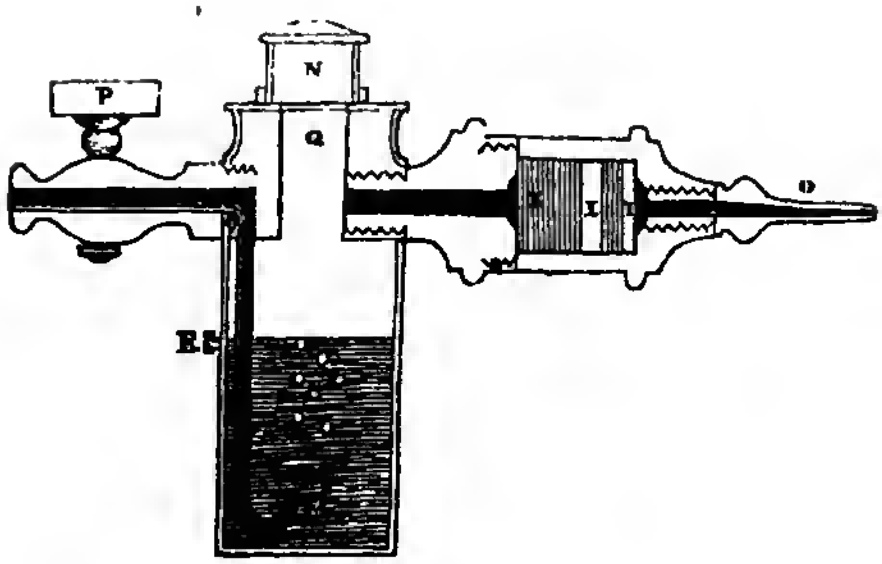
Westminster Abbey—Ditto ditto, at each.

The Adelaide Gallery West Strand, and Polytechnic Institution Regent Street—Open daily, Admission to each One Shilling

Fig. 1.



THE OXY-HYDROGEN BLOW-PIPE.



2.

THE OXY-HYDROGEN BLOW-PIPE.

In the first paper on the "Analysis of Minerals," (page 169,) we gave a plain description of the more useful mouth blow-pipes, with various remarks on the management and general application of these valuable instruments. We now present our readers with a similar account of the powerful apparatus due to the skill and knowledge of Mr. Goldsworthy Gurney, who in its construction has reduced what was previously a dangerous instrument to the most perfect safety and facility of management. We shall at once give Mr. Gurney's own description of it, and then adduce a few experiments to show its powerful action in melting some of the most stubborn substances, which mineralogy makes us acquainted with; observing that its intense action is derived from the inflammation of hydrogen and oxygen gases mixed together.

Fig. 1 represents the apparatus complete: A and B is the safety apparatus of which Fig. 2 exhibits a section, and through which the gas must pass from the gasometer D by the stop-cock C. G is a transferring bladder screwed to the stop-cock H, by which the gasometer is charged by an assistant during its action and such a quantity of gas supplied, as to keep up a flame for any requisite time. Between the gasometer and the charging bladder a valve is placed to prevent a return of the gas. I is a wood or pasteboard cap, so contrived as to unite lightness with strength: this is attached by four strings K to wires, which, passing through holes L L in the table of the instrument, are fixed to M a moveable press board below. When the requisite pressure or weight is placed on M, the cap I is drawn down horizontally and equally on the gasometer D: upon which, the gas is forced through the water-tube B, the safety apparatus A, and out of the jet C, at the end of which it is burned. If an explosion were to happen in the gasometer, the cap I would be thrown into the air, where, from its extent of surface and great lightness, its progress would be arrested before any mischief ensued. The gasometer bladder, or silk bag D is tied to a bladder-piece, which screws into a tube contained in the body of the table of the instrument. This tube terminates in the stop-cocks C and H.

Fig. 2 is a section of the parts AB of the preceding figure enlarged. P is the stop-cock which admits the gas from the gasometer to the water trough G, by a tube M, which reaches to the bottom of that vessel. L is the water with the gas rising through it. R is a gauge which indicates the proper height of the water. N is a cork, which, if an explosion happens on the surface of the water, is thrown up, or which can be taken out, when water is to be poured into the trough. I I' are chambers in the safety apparatus, intended, by means of the wire gauze partitions K to arrest the progress of a retrograde flame. O is the jet, of which various sizes should be provided, to be used at the will of the operator.

Combustion of the Carbonaceous Substance which floats on Pig-Iron.—When this substance was brought, *per se*, into contact with the ignited gas, scintillations ensued, resembling the sparks thrown out by the fire-work called a *flower-pot*, but on a smaller scale. When placed upon charcoal, the same appearance takes place, until fusion begins, when a bead of metal is formed upon the charcoal, and as soon as this begins to boil, such a rapid combustion takes place, that the whole of the metal is to be sent forth in a volume of sparks.

The bead exhibits to the file a bright metallic lustre like iron;—both before and after fusion, it is magnetic.

Fusion and Combustion of Carburet of Iron.—Dr. Clarke selected a small fragment, and brought it into contact with the united gases; its fusion immediately ensued, being accompanied, at the same time, by that vivid scintillation which was remarked in the preceding experiment, and which denotes the combustion of metallic bodies, especially of iron and platinum. No change of color was, however, to be observed in the flame; the light, as usual, was intense.

Upon examining the appearance of plumbago after fusion, its surface was covered with innumerable minute globules, some of which were limpid and transparent; others were of a brownish hue; and the large globules jet black; and seemed to exhibit a dark metallic lustre; but being so exceedingly minute, it was difficult to ascertain their real nature. They sunk in naphtha, disengaging bubbles of gas. Water produced no change in their appearance; they fell rapidly to the bottom, and remained there without alteration.

Oxide of Tin.—Wood-tin exposed to the ignited gases, communicates a beautiful blue color, like that of violets, to the flame. This, Dr. Clarke says, has not been before noticed.

If a pair of iron forceps be used as a support, the iron becomes covered with an oxide of tin, of incomparable whiteness. The fusion is rapid; and if the wood-tin be placed upon charcoal, the metal will be revived in a pure and malleable state.

Oxide of Iron.—In this experiment, Dr. Clarke made use of wood-iron, or fibrous red hæmatite. It was placed upon charcoal, and instantly fused; being reduced to a bead, which began to burn, like iron-wire, by continuance of heat.

Fusion of Platinum.—The largest drops which have fallen from melted platinum wire, when exposed to the utmost heat, weigh ten grains; but Dr. Clarke obtained drops of metal weighing fourteen grains, when the current of gas was diminished so as not to let the metal run off too quickly from the wire. By placing several globules upon a piece of charcoal, and suffering the whole force of the gases to act upon them, the metal is made to boil, and they all run together in one mass. In this way Dr. Clarke has melted more than 200 grains of platinum into a single brilliant metallic globule.

Combustion of Tellurium.—When tellurium is placed upon charcoal, and acted upon by these gases, it inflames with violence, accompanied by detonation, exhibiting a very beautiful flame. It is then volatilised in the form of a greenish yellow vapour, having a very disagreeable odour.

Combustion of Selenium.—The action of the ignited gases on this new metal, causes rapid volatilization, and the metal as it arises gives a beautiful blue color to the flame; at the same time the vapour has a strong odour of horse-radish.

Combustion of Antimony.—If, when this metal is in a state of ebullition on charcoal, it be thrown upon a deal board, or on the floor, it will divide into innumerable fiery globules, which burn with a vivid flame and brilliant scintillation.

Fusion of Iron and Iron-Filings.—When these were put upon charcoal, and acted upon by the ignited gases, they were speedily thrown into a state of active ebullition, and gave out a most vivid light, accompanied by beautiful scintillations.

Combustion of Copper.—Copper placed upon the

charcoal, boiled and burnt rapidly, giving out a delicate green flame.

Combustion of Gold.—If a slip of gold be exposed to the action of these gases in a state of ignition, it will burn with a brilliant green flame.

Combustion of Silver.—When a piece of silver is put on a piece of charcoal, before the jet of the compound blow-pipe, it burns with a light green flame.

Combustion of Phosphate of Lime.—This salt did not decrepitate. It was phosphorescent, and fused into a black slag; depositing on an iron forceps a cupreous colored powder. It scintillated with reddish-colored flame. Upon filing the slag, Dr. Clarke observed a globule of white metal, resembling silver, which does not alter by exposure to the air.

Fusion of Silex, Alumine, and Barytes.—Finely powdered silex was moistened with water; it became agglutinated by the heat, and was then perfectly fused into a colorless glass.

Alumine was perfectly fused into a milk white enamel.

Barytes fused immediately, with intumescence, owing to water; it then became solid and dry; but soon melted again into a perfect globule, or reddish white enamel.

Fusion of Strontites, Glucine, and Zircon.—Strontites placed upon the charcoal and exposed to the inflamed gases, exhibited the same phenomena: Glucine, in a similar situation, was perfectly fused into a white enamel. Zircon, under the same treatment, exhibited a similar appearance.

Fusion of Lime.—When the compound flame fell upon lime, the splendour of the light was insupportable to the naked eye; and when viewed through deep colored glasses, (as, indeed, all the experiments ought to be,) the lime was seen to become rounded at the angles, and gradually to sink, till, in a few seconds, only a small globular protuberance remained, and the mass of supporting lime was also superficially fused at the base of the column, through the space of half an inch in diameter. The protuberance, as well as the contiguous portion of the lime, was converted into a perfectly white and glistening enamel. A magnifying glass discovered a few minute pores, but not the slightest earthy appearance.

Fusion of Magnesia.—The escape of water caused the vertex of the cone of magnesia to fly off in repeated flakes, and the top of the frustrum that thus remained, gave nearly as powerful a reflection of light as the lime. After a few seconds, the piece being examined by a magnifying glass, no roughness or earthy particles could be perceived on the spot, but a number of glassy smooth protuberances, whose surface was a perfectly white enamel.

Professor Silliman, of Yale College, says, that we may, perhaps, be justified in saying, in future, that the primitive earths are fusible bodies, although not fusible in furnaces; in the solar focus, nor, (with the exception of alumine or barytes,) even by a stream of oxygen gas directed upon burning charcoal.

Fusion of Gun-Flint.—Gun-flint melted with great rapidity: it first became white, and the fusion was attended with ebullition and a separation of numerous small ignited globules, which seemed to burn away, as they rolled out of the current of flame; the product of this fusion was a beautiful splendid enamel.

Fusion of Chalcedony, Oriental Cornelian, and Red Jasper.—Chalcedony melted rapidly, and gave a beautiful bluish-white enamel, resembling opal.

Oriental cornelian fused with ebullition, and produced a semi-transparent white globule, with a fine lustre.

Red Jasper, from the Grampians, was slowly fused with a sluggish effervescence: it gave a greyish black slag, with white spots.

Fusion of the Beryl and Peruvian Emerald.—Beryl melted instantly into a perfect globule. and continued in a violent ebullition, as long as the flame was applied; and when, after the globule became cold, it was heated again, the ebullition was equally renewed: the globule was a glass of a beautiful bluish white color.

The phenomena exhibited by the emerald of Peru, were similar; only the globule was green, and perfectly transparent.

In addition to these and other interesting experiments, Mr. Hare fused porcelain, common pottery, fragments of hessian crucibles, Wedgewood's ware, various natural clays, as pipe and porcelain clay, fire-brick, common brick, and compound rocks, with equal ease.

Note.—The double blast bellows, or atmospheric blow-pipe, and also an ingenious one of French invention, is described in page 199, in an article on "Glass Blowing."

BONE AND THE SUBSTANCES COMPOSING IT.

Bone is composed of two parts, or principles; a hard part consisting of carbonate and phosphate of lime, and a soft part known by the name of gelatine. It is the beautiful manner in which these principles are proportioned which gives to bone that toughness and strength so thoroughly suiting it for the work it has to perform. Bones containing an excess of phosphate, or carbonate of lime, are brittle; and on the other hand, bones containing too much gelatine are possessed of little strength. In the bones of the ox about half by weight is found to be gelatine, in the remaining half the phosphate of lime bears the proportion to the carbonate of about 3 to 1. In fish bones the gelatine forms a larger relative proportion and consequently they are seldom so strong as those of animals.

The principles composing bone may be separated from each other with great facility; if a bone be burnt in an open fire, the soft parts are decomposed and dissipated and the earthy matter, still bearing the form of the bone, remains: this residue, which is the phosphate and carbonate of lime, is of a fine white color, and is known in the arts by the name of bone-ash. If a bone be immersed in dilute hydrochloric acid, the earthy matter forms with the acid products which are soluble in the water, while the soft parts remain behind, and are semi-transparent and so flexible, that a large bone thus treated may be easily tied in a knot. If a bone be boiled in water for a considerable time, the gelatine dissolves out from the bone, and forms with the water, a substance which sets on cooling, and is known by the name of size, or when prepared for culinary purposes it is called jelly; if this size be carefully evaporated down it becomes more compact, and is then known by the name of glue; thus portable soup is the glue of jelly; isinglass is a fish glue; the more ordinary kinds of glue are obtained from the bones, hoofs, &c. of

horses, cows and other animals, and on account of containing putrefactive matter are generally possessed of a disagreeable smell.

If bones be heated in a close vessel in such a manner that the products of the decomposition can be collected and examined, the gelatine will be decomposed; carbonic acid, ammonia, and a fœtid oil, (known by the name of Dippel's animal oil,) will be given off, while the remaining carbon of the decomposed gelatine with the phosphate and carbonate of lime will be found in the vessel in which the bones were decomposed. To obtain the animal charcoal free from the earthy matters which are mixed with it, it must be finely powdered and digested in dilute nitric acid, whereby the phosphate and carbonate of lime are decomposed and dissolved, the animal charcoal remaining behind: it must now be washed and thoroughly dried at a moderate heat. Animal charcoal as thus prepared is quite pure, and remarkable for its power of decomposing vegetable colors: if a small quantity of animal charcoal be placed in a phial, and the phial be now filled with deep colored port wine, corked and shaken, the charcoal will presently render the port wine nearly colorless; if the same experiment be tried with common charcoal, the color of the port wine is not in the least affected. G.C.F.

ACOUSTICS.

One of the most important uses of the atmosphere is the conveyance of sound. Without the air, deathlike silence would prevail through nature, for, in common with all substances, it has a tendency to impart vibrations to bodies in contact with it. Therefore undulations received by the air, whether it be from a sudden impulse, such as an explosion, or the vibrations of a musical chord, are propagated in every direction, and produce the sensation of sound upon the auditory nerves. A bell rung, under the exhausted receiver of an air pump, is inaudible, which shows that the atmosphere is really the medium of sound. In the small undulations of deep water in a calm, the vibrations of the liquid particles are made in the vertical plane, that is, up and down, or at right angles to the direction of the transmission of the waves. But the vibrations of the particles of air which produce sound differ from these, being performed in the same direction in which the waves of sound travel. The propagation of sound may be illustrated by a field of corn agitated by the wind. However irregular the motion of the corn may be seen on a superficial view, it will be found, if the intensity of the wind be constant, that the waves are all precisely similar and equal, and that all are separated by equal intervals, and move in equal times.

A sudden blast depresses each ear equally and successively in the direction of the wind; but in consequence of the elasticity of the stalks and the force of the impulse, each ear not only rises again as soon as the pressure is removed, but bends back nearly as much in the contrary direction, and then continues to oscillate backwards and forwards in equal times, like a pendulum, to a less and less extent, till the resistance of the air puts a stop to the motion. These vibrations are the same for every individual ear of corn. Yet as their oscillations do not all commence at the same time, but successively, the ears will have a variety of positions at any one instant. Some of the advancing ears will meet others in their returning vibrations, and as the times of oscillation are equal for all, they will be crowded together at regular intervals. Between these there will occur equal spaces where the ears will be few, in consequence of being bent in opposite directions, and at other equal intervals they will be in their natural upright positions; so that over the whole field there will be a regular series of condensations and rarefactions among the ears of corn, separated by equal intervals, where they will be in their natural state of density. In consequence of these changes, the field will be marked by an alternation of bright and dark bands. Thus the successive waves which fly over the corn with the speed of the wind are totally distinct from, and entirely independent of, the extent of the oscillations of each individual ear, though both take place in the same direction. The length of a wave is equal to the space between two ears precisely in the same state of motion, or which are moving similarly, and the time of the vibration of each ear is equal to that which elapses between the arrival of two successive waves at the same point. The only difference between the undulations of a corn-field and those of the air which produce sound is, that each ear of corn is set in motion by an external cause, and is uninfluenced by the motion of the rest; whereas as in air, which is a compressible and elastic fluid, when one particle begins to oscillate, it communicates its vibrations to the surrounding particles which transmit them to those adjacent, and so continually. Hence, from the successive vibrations of the particles of air, the same regular condensations and rarefactions take place as in the field of corn, producing waves throughout the whole mass of air, though each molecule, like each individual ear of corn, never moves far from the rest. The small waves of a liquid, and the undulations of the air, like waves in the corn, are evidently not real masses moving in the direction in which they are advancing, but merely outlines, motions, or forms, rushing along, and comprehending all the particles of an undulating fluid, which are at once in a vibratory state. It is thus that an impulse given to any one point of the atmosphere is successively propagated in all directions, in waves diverging as from the centre of a sphere to greater and greater distances, but with decreasing intensity, in consequence of the increasing number of particles of inert matter which the force has to move; like the waves formed in still water by a fallen stone, which are propagated circularly all around the centre of disturbance. These successive spherical waves are only the re-percussions of the condensations and motions of the first particles to which the impulse was given.

The intensity of sound depends upon the violence and extent of the initial vibrations of air; but whatever they may be, each undulation, when once formed, can only be transmitted straight forwards, and never returns back again, unless when reflected by an opposing obstacle. The vibrations of the aerial molecules are always extremely small, whereas the waves of sound vary from a few inches to several feet. The various musical instruments, the human voice, and that of animals, the singing of birds, the hum of insects, the roar of the cataract, the whistling of the wind and the other nameless peculiarities of sound, at once show an infinite variety in the modes of aerial vibration, and the astonishing acuteness and delicacy of the ear, thus

capable of appreciating the minutest differences in the laws of molecular oscillation.

All mere noises are occasioned by irregular impulses communicated to the ear, and if they be short, sudden, and repeated beyond a certain degree of quickness, the ear loses the intervals of silence, and the sound appears continuous. Still such sounds will be mere noise; in order to produce a musical sound, the impulses, and, consequently, the undulations of the air, must be all exactly similar in duration and intensity, and must recur after exactly equal intervals of time. If a blow be given to the nearest of a series of broad, flat, and equidistant palisades, set edgewise in a line direct from the ear, each palisade will repeat or echo the sound; and these echos returning to the ear, at successive equal intervals of time, will produce a musical note. The quality of a musical note depends upon the abruptness, and its intensity upon the violence and extent of the original impulse. In the theory of harmony the only property of sound taken into consideration is the pitch, which varies with the rapidity of the vibrations. The grave, or low tones, are produced by very slow vibrations, which increase in frequency, as the note becomes more acute. Very deep tones are not heard by all alike; and Dr. Wollaston, who made a variety of experiments on the sense of hearing, found that many people, though not at all deaf, are quite insensible to the cry of the bat or the cricket, while to others it is painfully shrill. From this he concluded, that human hearing was limited to about nine octaves, extending from the lowest note of the organ to the highest known cry of insects; and he observes, with his usual originality, that, "as there is nothing in the nature of the atmosphere to prevent the existence of vibrations incomparably more frequent than any of which we are conscious, we imagine that animals, like the Grylli, whose powers appear to commence nearly where ours terminate, may have the faculty of hearing still sharper sounds which we do not know to exist, and that there may be other insects hearing nothing in common with us, but endowed with a power of exciting, and a sense which perceives, vibrations of the same nature indeed, as those which constitute our ordinary sounds, but so remote, that the animals who perceive them may be said to possess another sense, agreeing with our own solely in the medium by which it is excited."

(Continued on page 341.)

OXYGEN.

(Resumed from page 300, and concluded.)

Ex. 27.—*Its Specific Gravity.* Fill a bottle with oxygen gas; turn its mouth upward, and withdraw the cork. The gas will not escape, as may be tried by holding a lighted taper within the bottle; some time afterwards it will be found present as at first. Hold this uncorked bottle in one hand, and a lighted match, or piece of lighted charcoal in the other, and pour the oxygen upon the light, in the same manner as pouring wine into a glass. The oxygen will fall upon it, showing that it is heavier than atmospheric air.

Ex. 28.—*Its Neutral Properties.* In a jar filled with oxygen, dip a strip of litmus paper, which will not be colored red; also a strip of paper tinted with turmeric, which will not be rendered brown. Thus proving oxygen gas to be neither acid nor alkaline, and yet oxygen is the chief cause of acidity and alkalinity.

Ex. 29.—*Stimulating Effects of Oxygen.* Let a person inhale from a bladder two or three quarts of oxygen gas. His pulse will be raised forty or fifty beats per minute, and afterwards he will feel himself considerably elated, and have a greater inclination for muscular exertion—so by depriving common air of oxygen the pulse may be lowered. These facts have been taken advantage of in medicine, as may be seen by many papers in Tilloch's "Philosophical Magazine."

Ex. 30. *Effect on a Glow Worm.*—Immerse a glow worm in a jar of oxygen gas, in a dark room. The insect will shine with much greater brilliancy than it does in atmospheric air, and appear more alert.

Ex. 31.—*Colors of Heated Steel.* Place the blade of a bright steel instrument in the flame of a candle, it will change, first into a straw color, then progressively into brown and purple, and finally into a bright blue, which, as Brande says, is because of the union of oxygen with the surface. Sword blades are rendered blue by subjecting them gradually to the heat of burning charcoal.

These colors upon steel are proved to be the effect of oxidation, because, unless the steel be in contact with oxygen, the color is not produced; thus when steel is heated under the surface of oil, or in hydrogen gas, it remains with its previous polish; even rubbing it with grease will prevent the oxidation.

[The above remark is in "Brande's Chemistry," but we rather doubt its correctness.—Ed.]

If copper be melted, cast into ingots, and while still hot, plunged into water, it becomes of a fine red color externally. Thus we can explain the cause of the irridescence seen occasionally upon lead, zinc, and brass, when cast in damp moulds; and also upon the surface of many minerals, as sulphuret of iron, the peacock ore of copper, &c.

Ex. 32.—*Colors of Metallic Oxydes.* Expose melted lead to the action of a stream of oxygen, and it soon becomes changed to a whitish grey powder, continuing to blow upon it with oxygen, it will become first lemon, then orange colored, in which state it is called massicot, or the protoxide of lead; the still prolonged action of oxygen, the heat being continued, changes it to minium, or red lead.

Ex. 33.—*Coloring of Gallates.* Make a saturated solution either of potass, soda, or ammonia, with pure gallic acid, so as to form a neutral gallate; it will be found colorless, but pour some of the solution into a phial of oxygen, shake it up, and it will become of a deep brown color.

Ex. 34.—*Restoration of the Color of Litmus.* The tincture of litmus, if long kept, often becomes colorless, if in a phial containing some of this discolored liquid a small quantity of oxygen be inclosed and shaken up, it will unite with the liquid and become instantly of its original blue tint.

Ex. 35.—The spirits of wine in thermometer tubes when colored at first by litmus, soon becomes white or lemon colored; if the tube be broken, the liquid thus exposed to the oxygen in the air, regains its original color, thus showing that it is not light which occasions the change.

Note.—It is upon the principal of these experiments that the changes of *sympathetic inks* is accounted for as well as that which takes place in the "*chameleon mineral*" as it is called.

Ex. 36.—*Restoration of the Color of Faded Silks* &c. Shut into a dry phial along with oxygen gas,

a piece of damp faded silk, print, or paper, which has been dyed with any vegetable infusion, such as indigo, arcbill, madder, &c.; it will imbibe the gas, and be restored to all its original brilliancy.

Note.—The above experiment is uncertain in its result, because of the mordants employed in dying, it also generally requires some days before perfect success is ensured.

Ex. 37.—Bleaching Effect of Oxygen. Place upon a piece of stuff, silk, &c., dyed with indigo, any substance which readily absorbs oxygen, such as potassium, and it will become green, by its after exposure to the air, or to a stream of oxygen, it again turns to blue as at first. By a process of this kind indigo is rendered perfectly white.

The peculiar combinations of oxygen, with the other elements, will be treated of in succeeding articles, either in connection with each particular base, or under the distinct heads of oxydes, alkalis, earths, acids, &c.

Ex. 38.—Change of Color in Sulphur. Melt in any vessel upon the fire, some pieces of sulphur, after a little time it will become red, and afterwards brown and tenacious; which changes arise from the absorption of oxygen, although it is so small a quantity as not to be appreciable.

The retort used for oxygen, from chlorate of potassa must be made not exceeding 1 to 2 ounces capacity. The operator should observe that the ebullition in the gas bottle is regular and continued, and the gas evolved steadily, which is easily done by plunging the beak of the curved tube in water. Deflagrating jars should always have wide mouths, and be lipped: being open below, a small depth of water will be found extremely serviceable in extinguishing the product of combustion. When phosphorus in combustion is introduced into oxygen, nitrous gas and nitrous oxyde, no attempt should be made at the close of the experiment, to withdraw the deflagrating spoon with phosphorus still burning, the light being too dazzling to do so without incurring the risk of contact with the lip of the jar, as well as a portion of it being ejected on the glass. If the spoon however be plunged into the water below, it is extinguished, and all such danger obviated. Should a fragment of burning phosphorus fall on the surface of the glass, it will certainly occasion its fracture, unless immediately extinguished. A drop of water only accelerates the accident, but a little dry sand or magnesia added, would extinguish the combustion and save the vessel from fracture. All chemical glass apparatus should be well annealed to resist sudden changes of temperature, and the cylinders should be stout, ground flat on the edge, and have plates of glass, ground, to be air-tight. When a watch spring is deflagrated in oxygen, it will be prudent to have a stratum of an inch of water in the dish, as the melted scoriæ which fall frequently penetrate the shallow porcelain tray used to transfer the gas from the pneumatic trough. The watch spring is passed through a cork which rests very [illegible] the orifice of the deflagrating jar, to allow [illegible] the neck; and in order to prevent its [illegible] the finger may gently press the cork. [illegible] are generally most convenient in practice when small; they are also for the most part too contracted or narrow in the beak; so that the in[illegible]tion of materials into the retort becomes a [illegible] of delay and difficulty, while stopper retorts are too expensive for many experiments.

SINGULAR ACTION OF THE SOLAR RAYS.

BY DR. DRAPER.

The sun's rays have the power of causing vapours to pass to the perihelion side of vessels, in which they are confined, but, as it would appear, not at all seasons of the year. For example, I have a certain glass fitted for making these observations, and in this vessel, during the months of December, January, and part of February, 1836-7, a deposit was uniformely made towards the sun; during the months of March, April, and part of May next following, although every part of the arrangement remained, to all appearance, the same, yet the camphor was deposited on the side furthest from the sun. From May until the present date, the deposit is again towards the sun. It does not appear that any immediate cause can be assigned for this waywardness. Does it exist in the sun's light? or in changes affecting the earth's atmosphere? or in imperceptible changes in the instrument with which the observation is made? as respects the latter, I think a negative answer may be given without any hesitation; but beyond a mere expression of the fact that these anomalous circumstances do occasionally occur, I would not be understood to speak decisively; if periodic changes like this do occur, which is doubtful, they have not been watched for a sufficient length of time, nor have I made sufficient variations in my trials to be able to refer them to any distinct cause. A large bottle containing camphor, which has been deposited therein for more than a year under ordinary atmospheric pressures, has uniformly showed a crystallization towards the light.

For making these experiments properly, it is necessary to possess an air-pump receiver, ground so true, as to be able to maintain a vacuum for several hours, or even days. A less perfect jar may be made to answer, by fastening it down to the pump-plate with cap cement, it will, however, be liable to leak when the cement becomes warm by exposure to the sun. For many of these trials, a barometer tube is sufficient. Those who are provided with a good pump and jars, accompanied with their proper transfer plates, will have no difficulty whatever.

Upon the plate of the pump, or one of the transferers, place some camphor in a watch-glass, supported by a stand; over this place a bell-jar, and exhaust until the difference of level of the siphon gauge amounts to half an inch or less; the further the rarefaction is pushed the better; remove the arrangement into the sunshine. In the course of five minutes, if the atmosphere be clear and the sun bright, small crystalline specks will be found on the side nearest to the sun, these continually increase in size, and at the end of two hours, many beautiful stellated crystals, from one-eigth to half an inch in diameter, will be found on that side, but on the other parts of the glass, only a few straggling ones here and there. Sometimes, as is the case in a result which I keep by me, the whole side next the sun is covered with a lamina of camphor, the other side containing none at all.

SUGARS.

Cane Sugar This variety is extracted in the tropical colonies from a gigantic *Gramen* named the Sugar Cane *(Saccharum Officinarum.)* Hitherto no success has attended the endeavour to cultivate this plant in our temperate climate. Algiers, with its burning climate, may in this respect become the most valuable colony of the French. It is extracted

in the colonies, hut the refining of it is carried on in Europe.

The juice ohtained hy expression is immediately heated to 140 degrees in a copper caldron, with a small quantity of lime, (one part to 800 of the juice.) It is scummed and reduced, and ran successively into smaller and shallower caldrons from the last of which it is transferred to a caldron placed immediately over the fire. There it is allowed to boil till it has acquired the specific gravity of 1.200 to 1.220, when it is filtered through a woollen cloth. It is again evaporated at a boiling heat till it hecomes syrupy; and then it is ladled off into flat coolers, from which, before it is quite cold it is passed into vessels pierced with holes, which are kept closed. At the end of twenty-four hours, it is stirred, to promote the crystallization, which then takes place after a few hoors' rest. The holes are now opened to allow the uncrystallized syrup to run out, and the crystallized portion is dried, and comes into the market under the names of Cassonade, Moscovado, or Raw Sugar. The syrup is afterwards evaporated till it ceases to yield any crystallizable sugar, when it receives the name of molasses, a sort of mother-water of raw sugar. It may still, however he employed in the preparation of rum, of oxalic acid, and of spiced or gingerhread. Raw sugar is yellowish, friable, and granular. To remove the foreign substances which color it and prevent the cohesion of its crystals, it must he refined. For this purpose it is dissolved in water, forming a syrup of the specific gravity of 1.230 to 1.260. It is then mixed with a tenth-part of its weight of animal charcoal and bullock's hlood, and heated. The mixture is repeatedly stirred, and, after being filtered through a woollen or cotton cloth, it is evaporated in a shallow caldron hung in slings. When the syrop is likely to hoil over, a small piece of butter is thrown in, which immediately calms the ebullition. When the syrop has reached the specific gravity of about 1.385, it is emptied into a copper cooler, where it is stirred to accelerate its cooling, and it is then put into earthen cones placed with the base upwards, and having a hole at the apex which is kept closed. When the sugar has completely cooled and concreted, this hole is opened to allow the syrup to drain off, which occupies about eight days; and, in order to remove the residual syrup, which impairs the impority and color of the granular sogar, the open base of the cone is covered with a paste made of clay, the water from which, filtering through the sugar, takes with it the hrown syrup and leaves the sugar white. It is then termed Clayed Sugar. The claying is in many instances repeated three times, and the process occupies aboot a month. The loaves are then taken out of the mould and dried. In order to ohtain sugar in the greatest state of purity, it is a second time suhjected to the process of refining, using the white of egg in place of hlood.

Maple Sugar. — By a similar process from 7,000,000, to 12,000,000 lbs. of raw sugar are annually made in North America from the sap of the maple *(Acer Saccharinum.)* Holes are made through the hark and into the wood of the trunks of these trees in the months of March, April, and May, into which tubes are introduced to lead the juice into vessels placed below. It is observed that the higher the holes are from the ground the more saccharine the juice is, and the more injury does the tree receive from its abstraction. Trees of a moderate size will yield in 24 hours about 14 pints of juice, whose specific gravity is from 1.003 to 1.006. The sap of the *Syringa Vulgoris* may he used in place of that of the maple.

Sugar of Beet Root.—In 1747, Margraff announced to the Academy of Berlin the discovery of a crystallizable sugar in beet-root. In 1787, Achard succeeded in extracting it on a large scale. In 1810, Napoleon directed the inquiries of the French philosophers to the perfecting of this process; and in a short time the beet-root became the rival of the sugar cane, whose product was withheld from them by the continental system. This manufacture is now in so flourishing a condition, and making progress, that this sugar may hear a comparison with the finest cane sugar. In 1829, there were in France 100 or 120 manufactories of this sugar, whose produce was estimated at 13,406,470 lbs. In 1832, the number of manufactories was 208, and the quantity of sugar produced amounted to 32,175,048 lbs.

The process employed in its extraction is nearly the same as that used for cane sugar. The juice of the beet-root, however, contains less sugar than that of the cane. If the beet-root be of good quality, it yields 70 per cent. of juice, which contains 4 or 5 per cent. of sugar.

The juice is heated to 170 degrees, and then lime is added in the proportion of 44 grains to each pint, and sometimes more. It is known that a sufficient quantity has been used when the sediment precipitates readily, leaving the liquid clean. It is then hoiled until the scum that forms on the surface begins to crack. The fire is then extinguished, the scum is removed, the liquid is drawn off, and a sufficient quantity of sulphuric acid is added to saturate the lime. Achard treated the juice first hy sulphuric acid, and afterwards saturated it with lime; and, perhaps this method would give a larger quantity of sugar. It is then evaporated as rapidly as possihle to the specific gravity of 1,116, and mixed with animal charcoal; after which it is hoiled down to the specific gravity of 1.242. It is then passed through a woollen cloth, after which it is clarified with bullock's blood, scummed, and rapidly evaporated, using a little hutter to keep it from boiling over. The operation of crystallizing and refining are performed precisely in the same way as with cane sugar. M. Crespel however, found that, by carrying on the evaporation in a stove, a greater quantity of sugar might be produced. This was also M. Achard's method, hut it is more expensive.

In the manufacture of beet-root sugar, a machine is now used hy which the roots are washed and placed under a hydraulic press, from which the juice flows into the caldron. Such a manufactory can be profitable only in proportion to the extent of ground proper for the cultivation of the beet possessed hy its proprietors. The soil ought to be from 8 to 10 inches deep, of good quality, and not gravelly. It is ascertained that 2½ English acres can produce about 80,000 lbs. which will yield about 2681 lbs. of sugar.

The three preceding kinds of sugar possess similar characters and crystallize in a similar manner. Their crystals, when obtained by evaporating concentrated solution in a stove, are flattened four or six-sided prisms, terminated hy dihedral summits. The finest crystals are obtained hy stretching threads across the cooler, round which the sugar crystallizes. In this state it is called *candy sugar.*

(Continued on page 334.)

THE CARNATION.

The following are what the florists call the good and requisite properties of a carnation:—1. The stem of the flower should be strong and straight, not less than 30 inches, nor more than 45 in. high, and able to support the weight of the flower without hanging down, which flower should at least be 3 inches in diameter.. 2. The petals should be long, broad, and stiff, easy to expand and make free flowers, the lower or outer circle of petals, commonly called the guard leaves, should be particularly substantial; they should rise perpendicularly, about half an inch above the calyx, and then turn off gracefully in a horizontal direction, supporting the interior petals, which should decrease gradually in size as they approach the centre, and with them the centre should be wall filled. All the petals should be regularly disposed, and lie over each other in such a manner as thet their respective and united beauties should meet the eye altogether; they should be nearly flat, or with only a small degree of inflection at the broad end; their edges should be perfectly entire, without notch, fringe, or indenture; the calyx should be at least an inch in length, sufficiently strong at the top to keep the basis of the petals in a close and circular body. 3. The middle of the flowers should not rise too high above the other parts. 4. The colors should be bright, and equally marked all over the flower, perfectly distinct, the stripes regular, narrowing gradually to the claw of the petal, and there ending in a fine point. Almost one half of each petal should be of a clear white, free from spots. 5. The flower should be very full of petals, so as to render it, when blown, very thick in the middle, and the outside perfectly round. These flowers are propagated either by seed or by layers: the first is the method for raising new flowers; the other is the way to preserve and multiply those of former years. To raise them from seed, that from the best double flowers should be selected, which will produce the strongest plants, and should be sown in April, in pots or boxes of fresh light earth, mixed with rotten cow manure, exposed to the morning sun, and occasionally watered. In a month the plants will appear, and in July should be transplanted into beds of the same earth, in an airy situation, at 6 inches distance, and there left to flower. When in flower, the finest kinds should be marked, and all the layers that can be, should, during the time of flowering, be laid down from them; these will have taken root by the end of August, and are then to be taken off, and planted out in pots in pairs.—*Gardener's Magazine.*

MISCELLANIES.

Vermillion.—According to Wehrlé, vermillion, similar to [illegible] be made by the following process:—[illegible] common vermillion in very fine powder, with the hundredth of its weight of sulphuret of antimony, then digest the sublimate with the sulphuret of potassium, and afterwards with muriatic acid; and, lastly, with a ¼ per cent. of gelatine, dissolved in water—wash and dry it. A very small portion of sulphuret of antimony is sufficient to impart to the vermillion a beautiful crimson color.

Effect of Gases on Vegetation.—M. Macaire introduced some plants of Euphorbia, Mercurialis, [illegible], Sonchus, &c., into vessels along with chloride of lime in the morning. When evening arrived the plants had not suffered, and the odour of the chlorine was as strong as at first. Next morning they were found withered, the smell of chlorine had disappeared, and was replaced by a very disagreeable acid odour. The same result was obtained on repeating the experiment several times. Nitric acid withered the plants during the night, but in the day time merely rendered some of them brown colored. Sulphurretted hydrogen produced no alteration when light was present, but destroyed them in the night by the absorption of the gas Muriatic acid gas acted in a similar mann

Leaden Moulds for Seals.—Upon the seal to be copied lay a piece of clean soft sheet lead, and strike it a smart quick blow with a hammer, which, if done with care, will drive the lead into all the impression without injuring the seal.

The Forest-Pruner's Golden Rules.—No branches to be cut off which do not interfere with the leader; no wound, thus or otherwise made, to be larger than an inch in diameter; and no pruning in autumn.—*Gardener's Mag*

Theatrical Red and Blue Fire. First Receipt for Red:—Dry nitrate of strontian, 1½ oz.; sulphur, 3 dr., 6 gr.; oxymuriate of potash, 1 dr., 12 gr.; sulphuret of antimony, 2 dr.; charcoal, 1 scruple.

The oxymuriate must be powdered by itself, and mixed with the other ingredients carefully on paper, otherwise it will explode, to the imminent danger of the operator. When thoroughly mixed, lay it on a tin plate, and set fire to it, when it will burst into a splendid red flame.

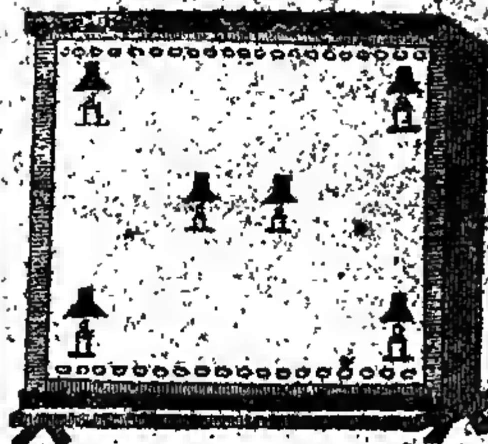
Second Receipt for Red.—Nitrate of strontian, 1 oz.; chlorate of potass, 3 dwts.; charcoal, 3 dwts.; meal powder, 3 dwts. Mix together as before.

Receipt for Blue Fire.—Nitrate of barytes, 77 parts by weight; sulphur, 13 ditto; chlorate of potass, 5 ditto; realgar, 2 ditto; charcoal, 3 ditto. Mix and inflame as for red fire. These receipts we have tried repeatedly, and know them to be excellent; the latter is not the blue light used among shipping, and in terminati[illegible]rical scenes, but the more delicate flame used in fairy and apparition scenes, &c., and which casts a peculiar soft whitish blue light, accompanied by much white smoke.

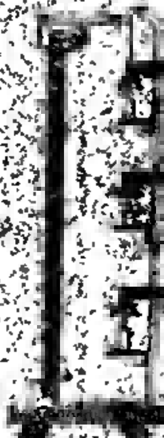
Rice Harvest in Germany.—A harvest of a very [illegible] description in Northern Europe has been reaped [illegible]o, near Brunn, in Moravia. After many trials, a Baron Von Reichenbach has, it ap[illegible] succeeded in bringing to perfection a field of [illegible] which in Germany, even more than with us, is an article of constant and extensive consumption. As the land where the crop has been grown is situated in a cold mountainous region, more than a thousand feet above the sea, and surrounded by forests, where the climate is too severe for the growth of grapes, his success is the more extraordinary. The seed was sown and raised entirely in water; in the first instance in a sort of hot bed, or hot water, for the water was a little warmed whenever during the spring the weather was cold enough to render it necessary, and it was then transplanted according to the method practised in Hindostan.

Revival of Plants.—Camphor is dissolved in alcohol until the latter is saturated; the alcohol is then put into soft water, in the proportion of two drops to half an ounce. Withered or apparently dead plants, put into this liquid, and allowed to remain there from two to four hours, will revive, if they have not been completely dead before being put in.

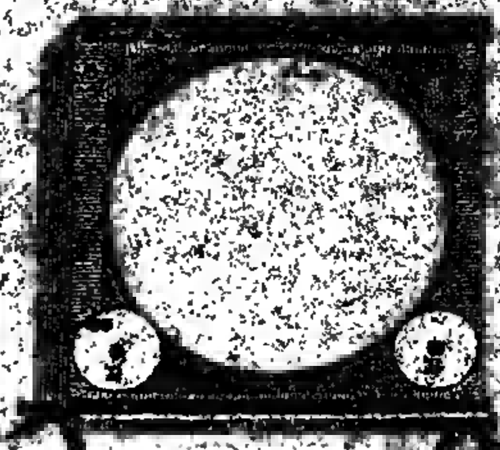
Fig. 1.



2.

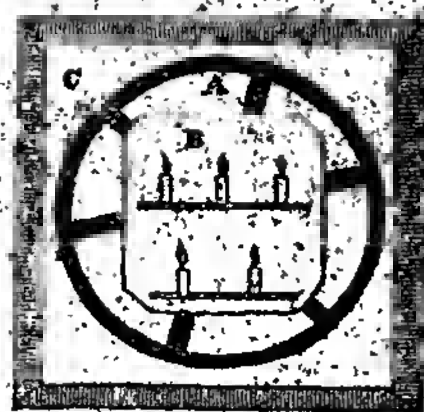


3.



4

5

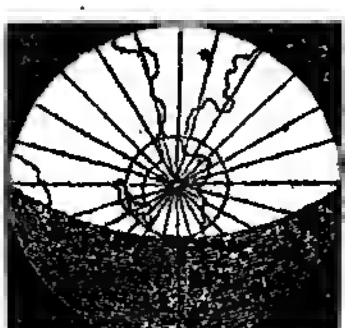


6

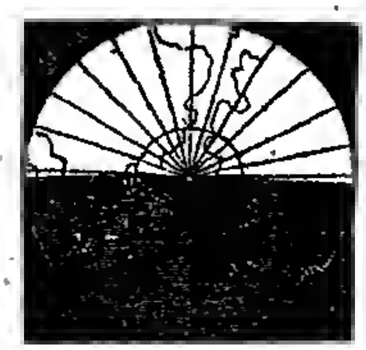
ASTRONOMICAL ILLUSTRATIONS.

7.

8.



9.



10.

11.

BOX FOR EXHIBITING ASTRONOMICAL TRANSPARENCIES.

To construct a box to exhibit transperencies may appear too simple to need description, and yet to show them in such a manner as to be adapted to scientific illustration, particularly in the science of astronomy, a few contrivances are necessary, so that the requisite clearness of delineation, uniformity of light, and capability of performing the various motions shall be united; and that with perfect darkness around, complete silence, and facility of management.

The first cut of our present number represents the transparency box of Mr. Wallis, certainly the best of our astronomical lecturers. The size of it is 5 feet square and 16 inches deep—painted white inside and black without; it rests, when in use, upon tressels; or upon a table adapted to it. The figure to the left hand at the top, (No. 1,) represents a view of the interior, with the arrengement of the six lamps or wax candles which enlighten the front. Over each candle is a chimney, made of tin and passing through the back of the box, to carry off the vitiated air; but these are not sufficient—the heated air will soon occupy the upper part of the box, and occasion the upper lights to burn dimly. To remove this, some holes are made at the back above the lights, or as is represented in the middle figure, a flap is made at the top, which answers the same purpose. At the lower part of the back of the box also are other holes. These are necessary to supply the lamps with fresh air to support their combustion—in other respects the box is air-tight.

Fig. 2 represents a section, to show the form of the chimney, and the groove with the slider or transparency within it, as in use. On the upper part of this section is seen a small circle; this indicates the position of a black curtain or blind within the box, made to roll up or down like a window blind, by a string which goes round a pulley placed outside the box. The curtain is necessarily in use when the scene is changed, as by its falling down it conceals the formation of the box within, whenever one transparency is taken out and another substituted.

The above may be considered the whole structure of the box itself, which is adapted to show all the usual transparencies, such as the planetary bodies, constellations, the laws of motion, the systems, views of the moon, and all the general facts which can be illustrated with common unchanging apparatus; but there are a few things in which, to render easily understood, motion is advisable, if not indispensable. These are the cause of day and night, the rotundity of the earth, and the unequal length of day at different seasons. In these a rotatory motion is required, and that is to be given without a dark axis appearing in the centre. It is done as follows.—Fig. 3 represents the box, furnished with a frame or slider in front, formed so as to exclude the light, except at a great circle in the centre, A. This circle is furnished with a hoop, which projects forwards about half an inch. The transparency to be used with this are stretched upon similar hoops, made of such a size as to move easily on the fixed hoop A. Put such a transparency upon A - it is moved round by the wheels B B, which are so placed as to bear the weight of the transparency; one of them, B, is furnished with a handle—the other is merely a friction wheel.

Fig. 4 represents one of these friction wheels, removed to show its simple formation. A is the part upon which the hoop holding the transparency runs. B is a rim around it, to prevent the hoop falling away outwards, and C the handle which turns it. There should be also a button, or something similar at the top of the box, to prevent the transparency hoop from falling forwards when revolving, though this is not represented. We will now show the application of the above box to the before-mentioned

ASTRONOMICAL ILLUSTRATIONS.

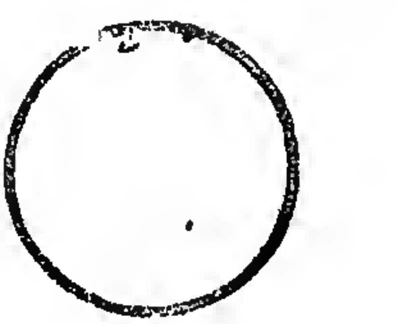
Day and Night.—Our object is not at present to explain the cause of the phenomenon of light and darkness, presuming that all our readers must be acquainted with the general fact, that the sun always illuminates exactly half of our globe, and that the latter turning on its axis offers first one part and then another to the sun's light, until, in each complete revolution, every portion of the earth shows in succession all the gradations of light and darkness. This is effectively represented in a transparency box, as follows: Fig. 7 shows the whole when at rest. The part in the centre, which represents a north polar projection of the earth, is the part which turns round. The broad ring, occupying the large space between it and the black frame-work, is the atmosphere. The upper part mid-day: the lower part midnight. On the right hand the evening: the left the morning. It must be remarked, that we must turn the central earth from west to east, or exactly contrary to the sun's apparent motion.

The picture of the earth is transected by twelve lines, meeting in the central pole—from one to the other then is two hours. Now supposing we begin at the lowest or midnight, and moving it gradually upwards, we shall arrive into a more illuminated atmosphere, through the haziness of morning to the brightness of noon day—when six spaces or twelve lines will have been passed. Continuing course, we shall soon lose this brightness for the duskiness of evening, and eventually once completing the round of twenty-four hours again be involved in midnigbt darkness.

From our above description of the transparency box, it is by no means evident how the motion of the centre, and rest of the atmosphere around, can be accomplished. To render it plain, look at Fig. 5—here five candles are seen in a frame, marked B. This frame is to be of tin for the sake of reflection. Behind B is a wheel A—this has sides to it something like a drum, except that they are open, and project outwards over the lights, and it is upon this that the painting of the earth is to be fitted, supposing that it has been stretched upon a hoop, which fits the front of the drum. When complete, the whole is entirely within the box, and offers no impediment to any slider being placed in the proper grooves. In the present illustration, the slider painted as the atmosphere, represents light at top and dark below. Fig. 6 shows a side section of this contrivance, and the manner in which the drum wheel is turned. A is the transparency on the hoop. B is the frame for the lights, which is kept steady by its own weight, being free to move on its centre. At the back of this is the wheel, which is turned round by the handle C. The pivot which supports the whole passing through the back of the box D.

[A box constructed thus is excellent for showing the *Chinese Fire-Works*, described in page 298.]

Rotundity of the Earth.—The principal popular arguments to prove that the earth is globular, are, the appearance of its shadow on the moon's disc, during the time of a lunar eclipse—that ships have sailed completely around it—and also that when a vessel disappears in the horizon, its upper masts and sail are in sight the longest. The last fact is shown in Fig. 8.—Suppose a man was on the look out, and seated at the foot of the mountain A, and another man was also on the look out from the top of the mountain, which would see the vessel D first? It is evident from the position of D that the man at the foot of the mountain could not see it at all—the extent of vision to him is the point C; but the man at the top of the mountain can see to the point D—the line A D being his apparent line of sight; also it is clear that the upper part of the vessel comes in sight the first, and that the hull will not be visible until a considerable space has been passed towards the mountain. Now if the earth were a flat surface, the hull would be first seen, because it is the largest part of the ship. Supposing the ship had passed the mountain, and were sailing down in a contrary direction, as towards B, the hull would first disappear, next the lower sails, and at length the upper sails and masts. The effect is managed thus:—Paint a picture of the earth, with a white rim around it for an atmosphere, and stretch it on a hoop, which fits tightly *within* the fixed hoop A of Fig. 3; and place on the outside of this hoop, as before directed, a hoop to be moved round without any transparency upon it, but bearing a wire with a ship cut out in card suspended from it. This being turned round makes the ship apparently in motion around the earth. The manner of suspending the ship is seen as follows:—



Length of Day and Night.—Figs. 9, 10, 11, are different views showing the cause of the unequal day-light at different seasons. Did the sun's path and our equator always coincide, day and night would be equal throughout the year in all parts of the world, and his light reach every day exactly from pole to pole. This we know is not the case, for the sun's path or ecliptic is, at Midsummer, as much as 23½ degrees to the north of the equator, he therefore illuminates a space 23½ degrees beyond the pole; and our hemisphere enjoys the delights of summer and of length of days. On the contrary, in the winter, the sun's path is as far south, as in the summer it was north. We are in darkness and cold, while the inhabitants of southern regions enjoy his light and heat, for 16 hours at a time, as we did in the former instance. At a period equally between them, that is, at the equinoxes, when the sun crosses the equator, the days and nights are equal. It is represented as follows:—A painting of the earth is placed upon the ring or hoop A, Fig. 3; and in front of this a semi-opaque slider or flap—first of the shape shown in Fig. 9; then one as in Fig. 10; and, lastly, one in Fig. 11—taking care that they shall be so far in front as not to impede the motion of the transparency, and have a hole cut out to allow the wheels at bottom to move freely.

ANIMAL LIFE IN NOVA ZEMBLA.

BY K. E. VON BAER.

The entire absence not only of trees, but also of every shrub which, without being sought for, might yet be sufficiently large to attract the eye, communicates to polar landscapes a peculiar and impressive character.

First of all, the power of measurement by the eye, owing to the want of the usual objects of known dimensions, viz., trees and buildings, distances seem less considerable than they really are, and mountains appear of lower altitude. This depends not only on the want of the customary objects, but also on a peculiar transparency of the atmosphere, for on dull days it is not so perfect as clear, and is not so striking in flat as in mountainous districts. On bright days, or at clear periods of the day, the air seems to be almost entirely colorless, and, as the heights visible to the eye are partly covered with snow, and partly exhibit a dark, and from the contrast, apparently a very dark colored rock, the slight color possessed by the air cannot be recognised. The mountains therefore seem to approach quite near to the spectator, and probably most so to those who have been accustomed to view mountains through a different kind of atmosphere.

Another effect of the want of trees, shrubs, and even grasses of considerable size, is the feeling of loneliness which seizes not only the man of reflection, but even the rudest sailor. There is nothing painful in this sensation; for it is of solemn and elevating character, and can only be compared to that powerful impression which a visit to Alpine heights leaves indelibly fixed on the mind. But, nevertheless, the movement of animals is occasionally witnessed in Nova Zembla. Sometimes a large gull *(Larus glaucus)* may be descried floating in the air, even at some distance from the coast, or a swift lemming running on the ground. Such occurrences, however, are not sufficiently frequent to give life to the landscape.

In still weather there is a want of sounds and sufficient movement, when an expedition is made into the interior, after the departure of the numerous geese which moult on the lakes. The few land birds of Nova Zembla give forth no notes, and the comparatively even less abundant insects produce no noise. The polar fox is only to be heard during the night. This total absence of sound, which is more remarkable in calm weather, reminds the traveller of the stillness of the grave; and the lemmings, issuing from the earth, moving along in a straight line, and then speedily disappearing again in the ground, may be compared to spectres. Notwithstanding these signs of animal life, it really seems entirely wanting, owing to the small amount of movement visible. In other parts of the world we are accustomed to have the slightest breath of wind rendered apparent by means of the leaves of lofty plants and trees; but a gentle breeze has no effect on the diminutive plants of the high north—they almost look like painted representation of vegetation. There are almost no insects employed in satisfying their little wants upon them. Of the numerous family of the

beetles only one individual was found, viz., a *chrysomela*, which is perhaps a new species. It is true that on warm days, and in mild places, for example, near little projecting masses of rock, a bee may be seen on the wing, but, as on moist days with us, no humming is to be heard. Flies and gnats are more abundant; but even these are so rare, and at the same time so quiet and dull, that they must be sought for in order to be remarked. The most striking proof of the scarcity of the insect tribe, is afforded by the fact, that the carcass of a walrus, which had lain fourteen days on the coast, was found to be just as devoid of insect larvæ as the bones of animals killed on previous years, although portions of dried flesh were not wanting.

The coast of Nova Zembla is much more animated than the interior, owing to the number of sea birds which there build their nests. Their number and variety are certainly not so great as on the Norwegian coasts, or on some islands and cliffs of Iceland, but still the sea-shore is thickly peopled by them in some places, on approaching which the traveller is received with a loud noise. The foolish Guillemot *(Uria Troile)* especially, whose abundance equals that of all the other birds taken together, lives in colonies of this description. The great grey gull *(Larus glaucus,)* named by the Dutch fishers, either from respect or want of it, the Burgomaster, builds its nest on the summits of isolated rocks, and allows no other bird to approach it. It seems to regard itself as the lord of this creation, for it has confidence enough, in the presence of a whole party of the fishers, to carry off fish that have been thrown by them on the sea-shore.

These birds are the best proof that more is to be obtained from the bottom of the sea than from the dry land. In fact, the great mass of animal life is here buried under the surface of the ocean. Small crabs are particularly abundant, and more especially Gammari, which surround a piece of flesh thrown into the water, almost in as great numbers as the gnats which collect about a warm-blooded animal in Lapland.

Although the vegetation is so sparing, yet it supports a multitude of lemmings. Gentle acclivities are frequently burrowed by them in all directions. But still the number of these creatures is not nearly so great as one would be led to believe by the multitude of excavations; for most of them are empty, as is easily proved by the use of dogs; but nevertheless, their number is so considerable, as to make us ask ourselves how so many lemmings can subsist on so meagre a vegetation.

Though not so abundant as the lemmings, Polar foxes are rather common. They find abundant food in lemmings, young birds, and the animals thrown ashore by the waves. Polar bears are rarely seen in summer, either because they avoid places where they scent human beings, or because they only collect at those points on the coast where there is ice. The rein-deer, also, owing to the number of walrus-fishers who pass the winter there, have become scarce, at least on the west coast, during the last few years. Not only were but very few killed during our stay in the country, but one of the parties who had spent the previous winter in Nova Zembla, and had been instructed to support themselves by hunting the rein-deer, had not been able to obtain any. Wolves and common foxes which, occasionally occur, at least in the southern half of Nova Zembla, seem never to have been numerous. With the above enumeration, the notice of the land mammalia would be complete, were it not that Messrs. Pachtussow and Kiwolka, during their winter residence in a hut, saw a little white animal, which they call a mouse in their journal.

The sea mammalia are more important: for, in their pursuit, many expensive expeditions are yearly fitted out by the inhabitants of the White Sea: whose success, however, is unfortunately so precarious, that they may truly be compared to a game at hazard. When the sea is unusually free of ice, the losses are very great; but the success of a single day may make up the loss of a whole year. For this reason these hunting undertakings have been renewed year after year for centuries, although they are sometimes complete failures.

The most valuable animal in these marine hunting expeditions is the walrus; and next to it is the dolphin *(Delphinus leucas)*, termed the white whale, but which there receives the name of *Bjelucha-Bjeluga*. Among the seals, the species which affords the richest return, both on account of its size and its abundance of fat, is the sea-hare *(Phoca leporina)*, Lep.

Of the cetacea, this sea contains, more especially a species of whale belonging to the subdivision termed Fin-fish or Balænoptera, with very short whiskers. They are but rarely seen in the sea round Nova Zembla, and one hears nothing of any being stranded on the coast. Nearer the north coast of Lapland, where they are stranded almost every year in the Bay of Motowsk, they are so numerous that it is surprising that early attempts have not been regularly followed up, and new enterprises carried on with perseverance for the pursuit of this animal. It may be at the same time remarked, that it is undoubtedly difficult to kill it. The Narwal *(Monodon monoceros)* is much rarer, and is only met with near the ice. As to dolphins, besides the *Delphinus leucas*, there is also the *Delphinus orca*, and a small species, regarding which I have not been able to ascertain whether it is the *Delphinus delphus* or *Delphinus phocæna*.

The marine mammiferous animals of Nova Zembla, would, therefore be the same as those known to occur in the Spitzenbergen and Greenland seas, if the Greenland whale extended so far. On the other hand, Spitzbergen and Nova Zembla differ in a striking manner in their feathered inhabitants. The latter indicates by its birds the proximity to a continent. It is richer in species, but is at the same time less interesting for the naturalist, as many of these species are the same which yearly visit us, and partly remain with us, but of which another portion proceed to Nova Zembla, in order to pass their breeding season in undisturbed tranquility.

ATMOSPHERIC ELECTRICITY.

The appearances indicating an approaching thunder storm are generally a dense, low, black cloud, in one direction, and a few ragged, light clouds, in the opposite part of the heavens. These latter gradually approach the former, stretching out long filaments until they collapse with it, and thus form in the air an immense charged conductor, possessing the same powers upon the bodies it passes over, or meets with in its passage, as our

common conductor has upon those presented to it. If a cloud of this kind meet with another cloud, differently electrified from itself, the electric matter flies off to all parts: hence arise flashes of lightning, and the air which has been divided by the passage of the fluid collapsing together, causes the awful report of the thunder, or what is still more frequently the case, the charged cloud passes over some part of the earth in a different state from itself, when the lightning darts downwards or upwards, to restore the equilibrium—upwards if the cloud be negative which is very rarely the case; or downwards if the cloud be positive; or if the elemental strife be between the two clouds, the fluid passes from the one to the other without touching the earth, and therefore is not to be apprehended. The resistance of the air occasions lightning to appear zigzag, or forked, but sometimes it descends in a straight line, and rolls along the ground like a ball: this is most to be dreaded, as it shows the fluid to be very near us, and also in vast quantity. In a thunder storm also we find that its violence increases, until a very vivid flash, and consequently a very loud clap of thunder, expends the violence of the storm and then soon subsides. It is thought by many, that at the time of this vivid flash, a body falls to the ground, which has been called a thunderbolt. This opinion, however, is quite erroneous: no body whatever of a metallic nature attends any passage of the electric fluid—the substance thus consecrated by superstition is a nodule of sulphuret of iron.

The very appearance of lightning induced philosophers long to believe that it was only a grander species of electricity, excited without the intervention of human art; but the proof that they should be actually the same fluid, and should arise from the same cause, and be subject to the same laws, was reserved for the comprehensive and active mind of Dr. Franklin. He made the bold assertion, and with a common kite brought lightning from the clouds, and proved his assertion by performing with it all the experiments then known. (See page 64 for a description of "The Electric Kite.")

The identity of lightning with the electric fluid does not depend for proof upon appearances only, their similarity is observed throughout all their numerous effects.

1. Lightning destroys animal and vegetable life, so does the electric fluid.

2. The rapidity of the passage of both tends to show their identity.

3. Lightning sometimes renders steel magnetic, so does electricity.

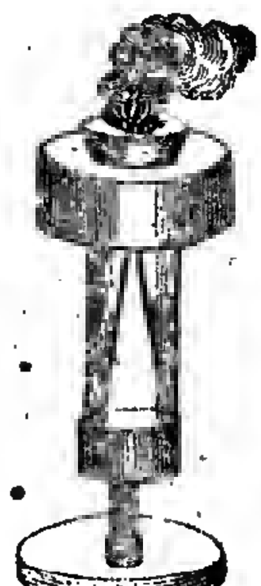
4. Lightning melts metals, so does electricity.

5. Lightning rends to pieces trees, houses, and other bodies opposed to its passage, so does electricity.

6. Lightning sets fire to stacks, ships, buildings, &c., and these effects are easily imitated by an electrical machine.

Their identity therefore is firmly established, and it becomes us next to consider by what means the electric fluid becomes so disturbed, as to give rise to these effects. The greatest cause, and one fully adequate to produce all these appearances, is evaporation.

Ex.—Place upon the cap of a gold-leaf electrometer a tin cup, in which place a piece of hot iron, or cinder from a coal fire, and sprinkle upon it a few drops of water. Immediately the latter rises in vapor the gold leaves will diverge with negative electricity.



Thus it is proved, that whenever water is rarefied by heat its capacity for the fluid is increased, it therefore carries up with it a large quantity, thus increasing what already exists there. The whole amount of the fluid thus disturbed may be imagined, by stating that 5,280 millions of tons of water are, as is supposed, evaporated from the Mediterranean sea alone in one summer's day. It must be observed, that other causes are also in action, as currents of wind impinging upon the earth's surface, the motions of all bodies, chemical change, &c., sometimes adding to this accumulation, sometimes decreasing it, and thus it is that different parts of the air are differently electrified at the same time. When this takes place to any great extent some phenomena occurs to restore the equilibrium between them. In pursuance of these ideas, it may be observed, that

1st.—Electrical phenomena takes place in all climates whenever the sun's rays have accumulated a considerable quantity of vapour, and in the hottest climates these phenomena are produced on a scale of the most tremendous magnitude.

2nd.—When evaporation is assisted by collateral causes, electrical changes occur with greater activity. The eruption of a volcano is always attended by lightning, and the regions that surround the extensive sands of Africa, where the action of the sun's rays is assisted by reflection from an arid soil, are remarkable for violent storms and tempests—the air roasted in its passage over those sands, producing a rapid evaporation of the first water it meets with, and becoming thereby so loaded with moisture as to evolve copious streams and showers on any sudden diminution of temperature: thus when it reaches the surface of the ocean on the W. of Africa, it occasions the dreadful hurricanes and terrific lightnings so common on the coast of Guinea; and such are also the electrical phenomena of all high ranges of mountains, for their icy summits occasion a condensation of the heated and moist winds which pass over them: hence the magnificent lightnings of the Cordilleras, and the coruscations of the Alps. In the tropical regions, the NE. and SW. trade winds are continually bringing masses of cool air towards the equator. The electric fluid is therefore disturbed, and thus are occasioned those universal electric diffusions which give the sky the appearance

of being covered in every direction with one continued sheet of lightning.

3rd.—Electrical changes are most frequent when evaporation and condensation succeed each other most rapidly—for instance, when a quick succession of rain and sunshine occurs, such variable weather is most frequently attended by thunder storms. Even the diurnal changes of heat and cold are amply sufficient to account for those ruddy tints and streaming flashes which are known as summer lightning.

SUGAR.

(Resumed from page 328.)

Grape Sugar.—Under this title are included the sugars which exist *naturally* in the *grape*, the *fig*, the *plum*, the *chesnut*, and the *dog-grass*, as well as in *mushrooms*, *honey*, and *diabetic urine*, and those which are obtained *artificially* from *woody matter* and *starch*. It hardly differs from the former, unless in its crystallization, which assumes a cauliflower shape. The mode of extracting it is different according to the composition of the juices of the various plants, and the presence or absence, as well as the nature, of their various acids and salts.

Grape Sugar properly so called. The grape juice is expressed, and its acid is saturated with chalk, or rather with powdered limestone. After the precipitate has been removed, it is clarified with blood or white of egg, and evaporated to the specific gravity of 1.321. It is then allowed to rest for a few days, when it will be found to have crystallized. It is then washed and pressed. To remove its color animal charcoal is employed. Proust gained the great prize offered by Napoleon for the discovery of an easy process by which sugar might be profitably extracted from grape juice in quantity sufficient for the demands of the south of Europe.

Sugar of Honey.—The purest honey is composed of crystallizable sugar similar to that of grape, and of uncrystallizable syrup, similar to *molasses*. The less pure kinds contain also an acid and a portion of wax; and those which are extracted from the combs with least care, such as the honey of Brittany, contain fragments of the larvæ, which render them liable to putrefaction. The most esteemed kinds of honey are those of Mount Hymettus, of Mount Ida, of Mahon, and of Cuba, and next them those of the Gatinais and Narbonne, whose mild climates are more favorable to the growth of the *labiated* plants than that of the north of France.

It has been much disputed whether honey is collected or produced by the bee. In order to reply to this question, it must be admitted that honey is, in the first instance, the food of the bee, and that besides, the juice of the nectaries of the flowers which the insect sucks is scarcely at all different from the honey which it deposits in the combs. It must also be admitted that a part of this juice having served for the nourishment of the bee must have undergone an alteration; and that consequently the unaltered portion which is deposited by the bee is the surplus which was not required for its nourishment, but disgorged and laid up as a provision against winter. This unaltered surplus is often mixed with what has been acted on, and hence the mixture of crystallizable and uncrystallizable sugar found in honey.

These two portions may be separated by washing the honey in alcohol, and compressing the mass between the folds of a thick cloth, by which means the whole of the uncrystallizable syrup is removed. The extraction of this sugar could not, however, be made a source of profit.

Sugar of Dog-grass (Triticum Repens) and Mushrooms.—It is by means of alcohol that the sugar of these two sorts of plants is obtained, after the juice has been evaporated to dryness. The sugar of mushrooms, which has less sweetness then cane sugar, crystallizes in long quadrangular prisms with a square base, and that of the dog-grass in groups of very delicate needles.

Sugar of Chesnuts.—The solution obtained by washing the mashed fruit with water is heated and filtered, after which it is concentrated; it slowly deposits the sugar, which must be separated by pressing from the substances which alter its properties.

Sugar of Diabetes Mellitus.—Subacetate of lead is to be added to the urine of persons labouring under this disease, which throws down the animal matter. It is then filtered, and the excess of lead is removed by a current of hydro-sulphuric acid. It is then evaporated to the consistence of a syrup, and the sugar crystallizes.

Sugar of Starch and Woody Matter, or Artificial Sugars.—The length of boiling required is diminished by using a larger proportion of sulphuric acid. The whole of the starch may be converted into sugar in a few hours, if it be treated with 1-10th of its weight of sulphuric acid. Fecula yields 104 per cent. of sugar, and this process is now carried on on the large scale. The acid previously diluted is heated by steam, and when it is almost boiling the starch is diffused in it. The operation is terminated in a few hours.

(Continued on page 363.)

TANNING, OR CONVERSION OF ANIMAL HIDES OR SKINS INTO LEATHER.

This process is founded on the affinity which is known to exist between the gelatinous part of the hide, and the tan or astringent principle of oak bark, and other vegetable substances.

It is well known that unless hides are speedily dried they become putrid, and consequently unfit for use. But even although they be successfully dried, they are still unfit for the manufacture of shoes and other necessary articles; being permeable to moisture, and liable to be soon destroyed by friction. Consequently, in almost every country where animal hides are used for purposes of convenience, they are made to undergo certain modes of treatment, which render them not only impermeable to water, but also tougher, and more pliable, so as to be easily and advantageously worked.

The combination of the vegetable astringent principle or tannin, with the gelatine, (which forms almost the whole of the hide,) changes it into leather, which is a substance totally different in its properties to the hide in the raw state. To tan a hide then is to saturate it with tannin.

Previous to the operation of tanning, the raw or green hides must undergo the process of washing and scouring, to free them from foreign matter, and to remove the hair. Hides are first put to steep in water, either pure or acidulated, to clear them of the blood and filth they may have collected in the slaughter-house. They are left to soak in the

water for some time, and then *handled*, or trod upon by the feet, the better to cleanse them of all impurities. If the hides are dry, they are steeped a longer time, sometimes for four days, or longer, according to the season of the year, and care is taken to draw them out once a day, in order to stretch them on a wooden horse or beam. These two operations are repeated till the skin becomes raised or well softened. A running stream is necessary in these operations, else the hides cannot fail of being ill prepared.

When the hides have been well raised, and softened, they are next freed from the hair, by the application of lime. In all tanneries pits are formed having their sides lined with stone or brick, in which lime stone is slacked, so as to form milk of lime. Of these there are three kinds, according to the strength of the lime. The hides intended to be scoured are first put into the weakest of these pits, wherein they are allowed to remain, until the hair readily yields to the touch.

If this liquor be not sufficiently active, the hides are removed to the next in gradation, and the time they have for soaking is longer or shorter, in proportion to the strength of the lime, the temperature of the air, and the nature of the hides. Those of sheep require to remain in the pits only a few days. It has been proposed to substitute lime water in place of the milk of lime. But though the lime water acts at first with sufficient strength, its action is not sufficiently permanent, and in order to succeed in clearing the hides, it is necessary to renew it occasionally. In some tanneries, after the hides have been kept in the pits for a short time, they are piled up in a heap on the ground; in which state they are suffered to remain for eight days, after which they are returned into the same pits from whence they were taken, and this process is repeated till the hair can be easily scraped off.

Hides may also be cleansed, by subjecting them to an incipient fermentation, produced by souring a mixture of barley flour in warm water, and soaking the hides in it, till they are sufficiently swelled and softened to admit of being cleared from the hair. In each tan house are placed several tubs full of this acid liquor, which is of different strengths in proportion as it is soured. In those containing the weakest liquor, the hides are first soaked, handled, and washed; and after two, or at most, three of these operations, they are sufficiently prepared to admit of being freed from the hair. If more easily procured, rye-flour may be substituted for barley.

The Calmuck Tartars employ sour milk with the same view, Pseiffer proposes the use of the acid water obtained from the distillation of coal and turf. It indeed appears sufficiently ascertained, that all the vegetable acids, and even diluted sulphuric acid, answer equally well for this purpose.

In some tanneries they cleanse the hides by throwing salt over one-half of the skin, and doubling the other half over it; in proportion as each hide is salted, they are laid one above another, and the whole are covered with straw or flax; fermentation soon begins, after which they are turned once or twice daily, until they are found to be in a proper state for removing the hair. They may be cleansed, however, much in the same manner, without the employment of salt, by piling them up on a bed of litter, and covering them with the same material for twenty-four hours. At the end of this period they are turned over, and afterwards examined twice a day, in order to ascertain when the hair may be readily removed.

In some tanneries the hides are buried in dung, while in others, they are simply exposed in a close apartment, termed a smoke house, heated by means of a tan fire, which gives out smoke without flame. The hides are suspended on long poles placed across these apartments, which are much heated.

All the methods in which fermentation is employed are termed heating processes. In whatever manner this operation has been conducted, as soon as the hair is in a fit state to be removed, it is scraped off, on the wooden horse, by means of a blunt knife, or by a whet-stone. This operation is not only intended to remove the hair, but likewise the scarf-skin or epidermis, which is of a very different nature from that of the true skin. It is insoluble in water and alcohol; is soluble in acids, but not susceptible of combination with tan, so that when left on the hide the tan can only penetrate through the under side, by which means the process of tanning is rendered extremely tedious.

There are many vegetable substances which possess the tanning principle, or tannin; but those which possess most, are the oak, alder, willow, and Peruvian barks, also the gallnut. The Peruvian bark, from its scarcity and high price, is only used in medicine. As oak bark possesses more tan than any other vegetable substance it is generally used for tanning. This bark, being stripped from those trees which are cut down in the spring of the year, is dried in covered heaps, in the open air. It is then ground to a coarse powder in a mill, and mixed with water in the tan-pits. The infusion or liquor which is of a brownish amber color, is called ooze; but is, properly speaking a solution of tannin and other vegetable matters.

The hides being scoured, raised, and softened, are first subjected to the action of weak ooze in one of these pits; here they remain for several weeks, and in the interim are frequently agitated, or handled. From thence, it is removed to a pit containing a stronger infusion, where it remains for

[illegible]

all the tan. It is then immersed in a still stronger infusion, and so on. When the hide has attained the color of cinnamon-bark on its outside, and when its internal parts are equally brown when cut through with a knife, it has received its full dose of tan, and is converted into leather. But if a white or greyish streak appear in the centre of the hide or skin, it is to be again immersed in the tan-pit.

Calf-skins require only about two or three months before the process of tanning is finished, whereas ox-hides are not perfectly converted into leather for six, eight, or even fifteen months.

When perfectly tanned, the hides are taken out, drained, passed between two iron cylinders, that they may become pliant, and are then hung up in a drying house, until they become perfectly dry by exposure to the air. The smaller hides now undergo the operation of currying, which renders them pliant, and reduces them to an uniform thickness. This consists in cutting, soaking, paring, scouring, stretching, and oiling. The leather is then blackened by a composition of lamp-black, oil, and tallow, which is rubbed hard into the fleshy side. It is now fit for sale.

It is to be observed, that leather would be tanned much sooner, and equally well, if the tan-pits were made within a building, so as to be secured from rain; and if the building were furnished

with flues or steam pipes, so as to keep the temparature of the vats constantly at a full-summer heat. Another important improvement might be made in tanning, if the skins were hung vertically in the pits, so that the tanning liquor might, from the first part of the process, touch every part of the skin equally.

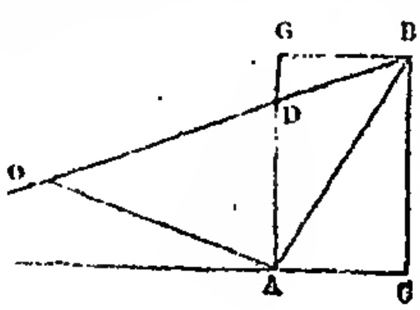
Continued on page 357.

ENGRAVING IN STEREOTYPE.

A SUBSTITUTE for wood engraving has lately been devised. The process is, as far as hitherto developed, as follows:—A smooth and level plate of metal is covered with a thickness equal to that of the projecting part of type of any ductile composition which will bear heat; what the inventor proposes to use, he does not divulge, but it is believed that many sorts of potter's clay will answer the purpose. While this is in a soft state, the design is, as it were, etched with a sharp instrument, care being taken that every line shall penetrate through the layer of composition to the surface of the plate. The great advantages here are, that the engraver has a much more easily-worked material than boxwood to operate upon;—that the design is cut into the material, as in copper-plate engraving, instead of having to be left in high-relief, which is an elaborate and dilatory process;—and that it is executed without the necessity of *reversing the design*, a point of great importance, especially where letters and inscriptions are required; these, of course, had always to be cut the backward way; by this method they are cut just the same way as they are to appear finally upon the paper. When this portion of the process is finished, all that remains is to harden the composition, and take off a plate, or any number of plates, in stereotype metal, in the same way as if it were the plaster-impression from a page of letter-press. These, of course, are to be printed from in the usual manner. Should the project succeed, the cost of engravings of the kind will be very greatly reduced.

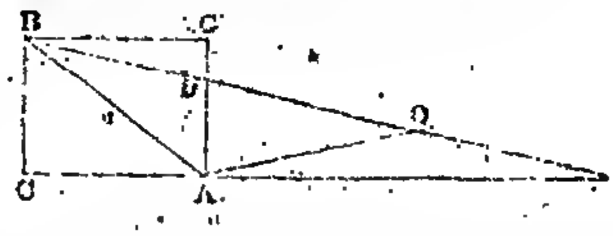
To the Editor.

DEAR SIR.—In page 312 of your Magazine, a correspondent has replied to the query—103: "Is there any way of trisecting *an angle* geometrically?" (which, of course, means *any given angle*,) by an extract from a French author. Now, it is quite clear that Hibernicus either has not understood Montucla, or that they have both fallen into an error; for, supposing it to *be possible* to construct the figure so that the part D E of the line B D E shall be equal to twice the diagonal A B, (for doing which no instructions are given,) then has he only trisected half a right angle, (which can be done in a much simpler manner,) and if the given angle should happen to be greater or less than half a right angle, then his method would fail, as the following will prove.



Let A B C be any given angle less than half a right angle; construct the figure as on page 312; then, by Montucla's proof, the angle O E A is equal to half of the angle A B D; so far he is right; but because the line G B is the opposite side of a parallelogram to A C, it is parallel to it, therefore the lines G B and E C are parallel, and the line E B cuts them, consequently the angle G B E is equal to the angle O E A; but because the G B C is a right angle, and the angle A B C is *less* than half a right angle, the angle G B A must be *greater* than half a right angle, therefore the angles O E A and A B D together, must be *greater* than half a right angle, consequently they are *not* equal to A B C, and, therefore, A B C is *not* triple of D E A.

Again, if the angle A B C is *greater* than half a right angle, then the angles O E A and A B D together, must, by the same rule, be less than half a right angle, therefore *unequal* as before.

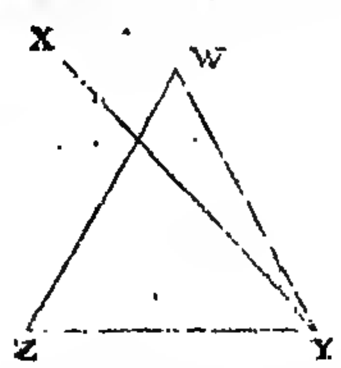


With regard to Hibernicus's own method of drawing the line, twice of A B and once of A G, in order to make the part D E equal to twice of A B, it may, by a parity of reasoning, be easily shown to be correct only in one particular circumstance, and, therefore, not meeting the general proposition.

Now, if the angle A B C (fig. 2) be equal to, or more than, half a right angle, the line G B must be greater than the line A G; but because the line D B is the hypothenuse of a right angled triangle, it must be greater than the line G B, therefore much greater than A G.

Should, however, the angle A B C be less than half a right angle, it is true that at *one* particular angle, B D would equal A G, but *only* at that *one* angle.

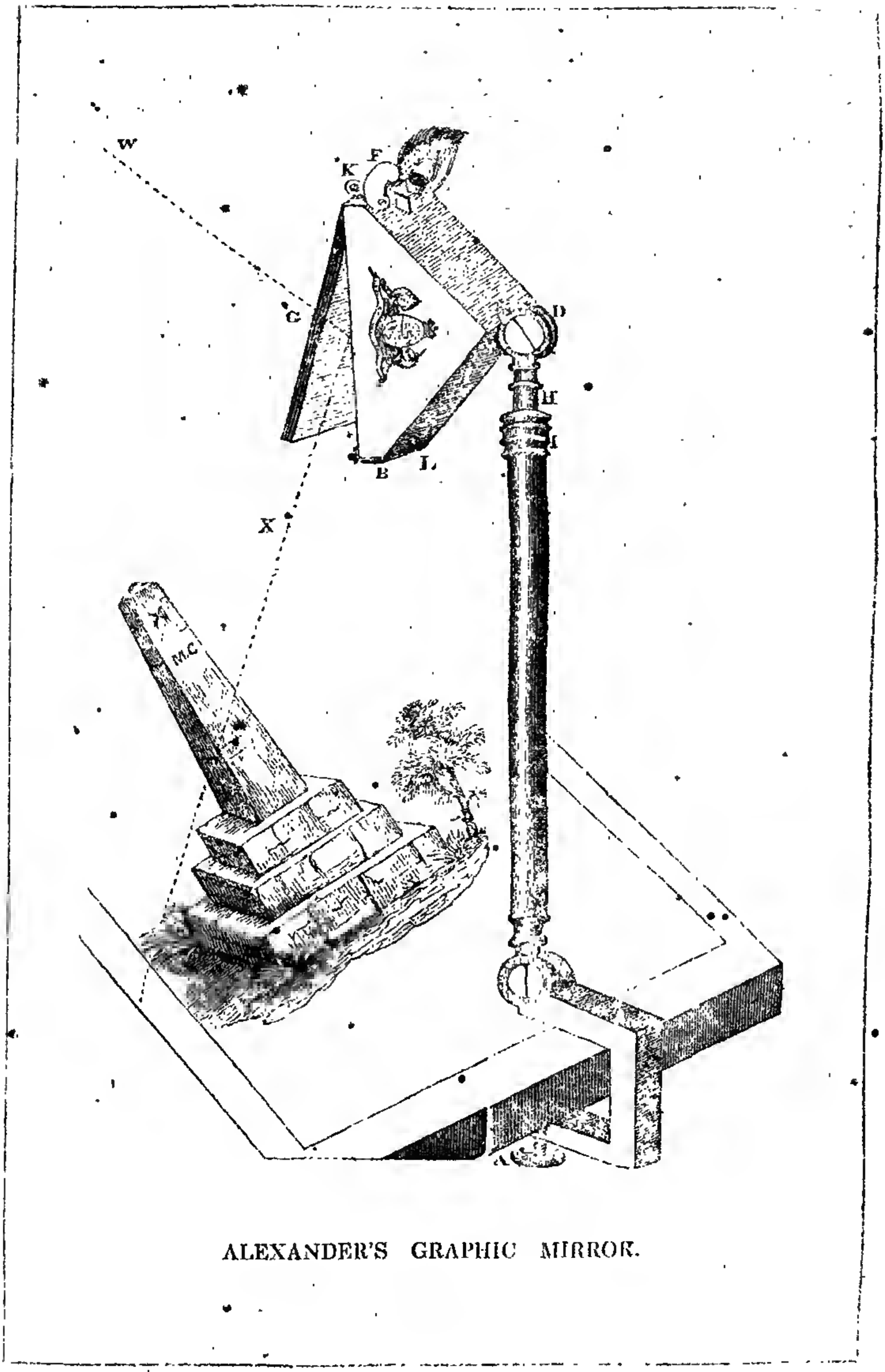
I have stated that half a right angle might be trisected a much simpler way; it is thus—



Let X Y Z be half a right angle; cut off any part of the line Y Z at Z, and construct upon it the equilateral triangle W Y Z; the angle W Y X shall equal one-third of X Y Z.

Because all the interior angles of a triangle, (Euclid, Book 1, Prop. 32;) are equal to two right angles; the angle W Y Z must be equal to one-third of two right angles, consequently two-thirds of one right angle; but X Y Z is half a right angle, take it away from W Y Z and it leaves W Y X equal to one-sixteenth of a right angle, therefore W Y X is one-third of X Y Z.

Your's sincerely, S.

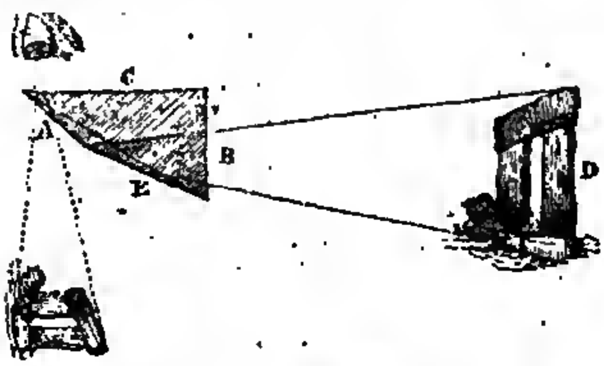


ALEXANDER'S GRAPHIC MIRROR.

WOLLASTON'S CAMERA LUCIDA, AMICI'S DITTO, AND ALEXANDER'S GRAPHIC MIRROR.

Among the most useful of optical instruments are those which enable persons, unacquainted with perspective, to take correct views of extended scenes, or of isolated objects, such as the Camera Obscura, the Camera Lucida, &c. The latter instrument, in its different modifications, it is our present object to explain.

The Camera Lucida is an invention of Dr. Wollaston, in 1807. It is more compact than the Camera Obscura, and adapted to delineate objects in a superior manner, though it must be admitted that the difficulty of using it is extremely great.—This arises chiefly from the impossibility of the person using it, seeing the point of his pencil and the reflected object at the same time, besides which the stress upon the eye is very injurious, if even moderately long continued. The construction will be seen by the following cut. The general form of it is similar to that of the Graphic Mirror, represented on the foregoing page, to which we shall afterwards refer.



Let the trapezium A B C E represent the end of a prism of glass, having its perpendicular side B presented to some object as D. The rays of light from this object pass through the prism until they are intercepted by the side E, which makes, with B, an angle of 67½°—here being thrown off at a similar angle, they strike the side A, which side makes, with E, an angle of double this, or 135°. At this place they are again reflected towards the eye, looking at the prism from above. They will, therefore, be seen at the horizontal surface C; but this being transparent, they will seem seated below it upon the table, or anything else which may be underneath, their vividness depending (other things being the same,) upon their nearness or distance from C. The nearer to C, of course, the more brilliant they will appear. If the eye be thus placed, and so as to look wholly through the prism, it would see the reflected object only, and if a pencil be held ready to trace it, the pencil would be invisible, because the rays of light from the pencil strike the side of the prism at A, and are reflected from it at an angle equal to that of their impingement, therefore never reach the eye at all. In the next case, suppose the eye looked downwards, but without looking through the prism, it would see the pencil, but not the object. The difficulty, then, lies here, that the eye at the same time must look at two objects, and must be directed so as to look over the edge of the prism, and half through the air alongside of it.

Amici contrived a Camera Lucida, which is a very great improvement upon that of Wollaston.

Suppose A to be a triangular prism of glass, or else a metallic speculum, having its upper side reflective, and connected, by one of its other sides, to a piece of plate glass D E C. The angle which the reflecting surface makes with the side of the

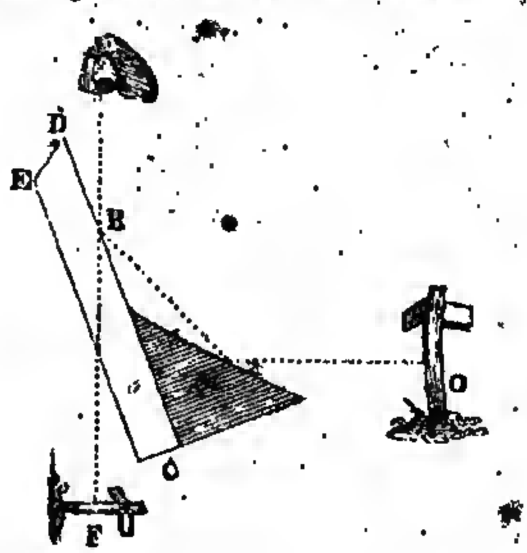
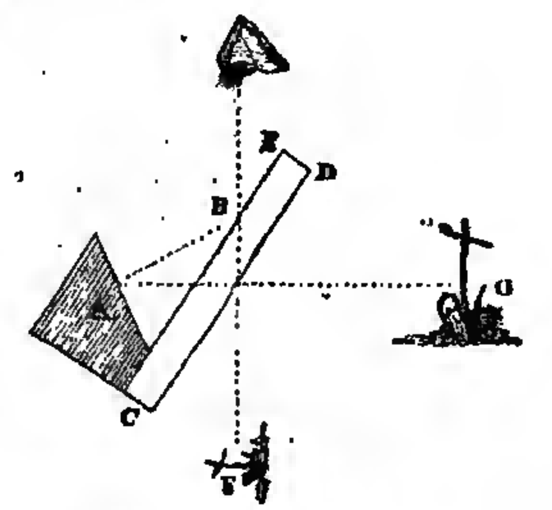


plate glass being 135°. The rays from the object O impinge upon A, are reflected to B, and again to the eye, which, looking downwards, sees the object at F, through the piece of plate glass D E C. The pencil is also seen through the plate glass, at or near the same point; and as both are seen through the same medium, much less fatigue to the eye, and facility of management is acquired, than by Dr. Wollaston's instrument, where the sight is to be carried through media of such different density as glass and the air.

Another construction, which is also due to Amici, is as follows:—



Let A represent the mirror upon which the light from the object O is reflected. (It is to be observed, that in this instrument, as well as some of the others, the light traverses through the piece of plate glass, yet as the sides of it are exactly parallel, it is not diverted from its course;) and D E C the glass as before. The light passes to the inner side of A, thence to B, and from B to the eye above, which beholds the object at F, seen through the glass as before.

The Graphic Mirror.—This instrument is the invention of Mr. Alexander, of Exeter, and appears to be superior to either of the former instruments. The construction of it will be easily understood from the preceding remarks, (see figure on page I.) The upper part of the instrument consists of a triangular box, having a fixed reflecting mirror or looking glass within it, and a transparent plate of glass in the front, and which is capable of adjustment. The rays from the object pass through the

glass to the reflector, and upwards to the eye, which sees them by looking through the small square hole at the top; when they appear at X.

The form or general frame-work of all these instruments is similar, and easily understood from the cut. The management of the instrument is best given in the inventor's own words, especially as they are applicable to all similar contrivances.

"The instrument being fixed by the clamp and screw A to the table and paper on which the drawing is to be made; look through the eye-hole F, having the front of the case B, which contain the glasses opposite the object to be copied, adjusting it by means of the joints C and D, getting the first line perpendicular, the whole of the tracing will prove to be in true perspective.

"If objects can be seen distinctly on the upper part of the paper, and not on the lower, incline the case B downwards by the joints C and D, until the reflected image is on the part of the paper required.

"Many persons, upon first attempting to use the instrument, occasionally lose sight of their object or pencil by an unintentional motion of the eye;—to avoid which, contract the eye-hole F by means of the eye-piece which covers it.

"The greater the distance from the object, and the higher the case containing the glasses is from the drawing paper, the larger the image will be represented, which is obtained by the sliding tube H, and fixed to any point by the tightening screw I; on the contrary, the nearer the object and shorter the instrument, the smaller the drawing. The sliding tube H is divided for the purpose of ascertaining the height of the instrument, should the drawing not be finished at one time.

"Some little attention is necessary to the position for taking profiles, sketching flowers, &c.—Darken one half of the window to shade the instrument, and place the object on the opposite part of the table in the light, having the table close to the window; the latter always to the right hand, as in the manner usually adopted by artists when taking likenesses.

"The eye-hole F should be kept closed when the instrument is not in use. Should the mirror become dull from the damp or dust, remove the bottom B by means of the screw L. Slide the front glass gently downwards for the purpose of cleaning the mirror. Care being taken the instrument will be as perfect as ever."

Should any of our readers not fully understand the above, they may see it at Messrs. Ackerman's, in the Strand.

ANIMALCULES, OR MICROSCOPIC AND INFUSORIAL ANIMALS.

Of the multiplicity of objects, which the almost incredible powers of the microscope have brought under our observation and scrutiny, perhaps that class of animated beings denominated animalcules, may be considered the most remarkable. The bare knowledge that there are myriads of atoms (and, in the scale of living creatures, we can call them nothing else) existing in a single drop of water, recreating and executing all the various functions and evolutions with as much rapidity and apparent facility as if the range afforded them were as boundless as the ocean, must carry with it an intensity of interest to the mind of every human being; of every one, at least, who is at all accustomed to meditate on the perfections of nature, and to recognise and adore the hand that guides her through all the vast variety of her stupendous operations.

The term animalcule, which implies nothing more than the *diminutive* of animal, has been commonly used to denote those living creatures inhabiting fluids, which are too minute to be scanned, or even seen by the naked eye; such, for instance, as those produced in inconceivable numbers from infusions of animal and vegetable matter; it comprehends as well such as are found in, and are peculiar to, the bodies of larger animals.

In the variety of systems that have been put forth, respecting these extraordinary creatures, the main characteristic of each have referred either to a difference in their size, or to the general appearance of their external forms. Until the introduction of vegetable coloring into the fluid, which supplies them with food,—an experiment that has been attended with very successful results,—these creatures were commonly supposed to be entirely devoid of internal organization, and to be nourished by the simple process of cuticular absorption. By the application of colored substances, which, moreover, have been found to invigorate rather than to depress the animalcule, and to mantain it in the full exercise of all its functions, this erroneous notion is set at rest, and an internal structure is discerned in some, equal, if not surpassing that of many of the larger invertebrated animals, and comprising a muscular, nervous, and, in all probability, vascular system; all wonderfully contrived for the performance of their respective offices.

The most obvious portion of their internal structure is undoubtedly that connected with the digestive functions; and hence it is that Ehrenberg has selected this as the leading feature of his arrangement, denominating his two grand divisions of the Phytozoa, Polygastrica and Rotatoria; the former of which includes such as are possessed of several distinct stomachs or digestive sacs; and the latter such as have true alimentary canals, and rotatory organs provided with a number of cilia aptly disposed for promoting the objects of life: these two grand divisions of the Phytozoa are afterwards subdivided into families and other minor branches. The cilia, in their different combinations, supply the means of locomotion, propelling the creature in many cases with great rapidity through the water: they are apparently stiff, like eye-lashes; and from Dr. E.'s description of some of the larger ones, they issue from bulbous substances at their bases, and being acted upon by muscular fibres are capable of being moved to and fro in particular directions, so as to occasion a current of the fluid to flow towards the mouth of the animalcule, by which it is furnished with fresh water or food. They are sometimes disposed, as before stated, round certain organs of a circular form, which, on account of their peculiar vibrations giving the appearance of a rotatory action, are termed rotatory organs. A second curious feature in the construction of some of these minute creatures are the *setæ*, or bristles, attached to the surface of their bodies: these short moveable hairs in all probability act as fins, and contribute greatly to their means of motion. The third feature are the *uncini*, or hooks, setaceous appendages curved at their extremities, and serving the creature to attach itself to any object it chooses. A fourth are the *styli*, jointed at their base, and differing from the cilia in respect of their being unable to effect a rotatory motion: these, however, are more flexible, and have more play than the *setæ*. In-

dependently of these peculiarities, some animalcules possess the extraordinary faculty of thrusting out, or elongating portions of their bodies at various points, which, assuming the appearance of legs or fins are termed *variable processes*, and enable the creature to walk or swim.

It was a favorite hypothesis with naturalists, some years ago, that the class of animalcules under consideration was entirely nourished by cutaneous absorption, and that no suitable organs for transmitting and digesting food were discoverable. Baron Gleichen was the first who brought the truth of this theory to the test; for having tinged some water containing animalcules with carmine, he found on the second day that only some distinct cavities in the interior of their bodies were filled with the coloring matter, evidently demonstrating the existence of an alimentary structure: here, however, he left the subject, and it is to Dr. Ehrenberg's further investigation of it that we are indebted for an accurate description of their different forms. In more recent experiments it has been found advisable to employ vegetable coloring substances in their pure state; such, for instance, as sap green and indigo, which, together with the valuable acquisition of an excellent instrument, enabled the Doctor to contribute much to our previously imperfect knowledge of this branch of natural history.

Method of procuring them.—In the selection of substances for infusions, such as stalks, leaves, flowers, seeds of plants, &c., care must be taken that there be no admixture of quinine in them, or the intention will be frustrated. Immerse these, whatever they may be, for a few days, in some clear water, when, if the vessels which contain them be not agitated, a thin pellicle or film will be discerned on the surface, which, under the microscope, will be seen to be inhabited by several descriptions of animalcules; the first produce are commonly those of the simplest kinds, such as the Monads. In a few days more, their numbers will increase to such an amazing extent, that it would be utterly impossible to compute those in a single drop of the fluid. After this, again, they will begin to diminish in numbers, and are generally supplanted by others of a larger species and more perfect organization;—such as the Cyclidia, Paramesia, Kolpodia, &c.—It is worthy of remark here, however, that in their production they do not pursue any regular order, even in similar infusions. If the vessel be large, and the circumstances under which it is fixed sufficiently favorable, a still higher description of animalcules will succeed, viz., the Vorticella, and, lastly, the Brachinni; and thus a single infusion will repay for the little trouble of making it, with a great variety of species. Water in which flowers have been steeped will be found to abound also with animalcules; and it is remarked by G. Leach, Esq., that the leaden troughs constantly appropriated for birds to drink out of, contain several descriptions of them, and more especially those of the wheel genus. In ponds, too, especially in the shallow parts, near the edges, and in the immediate vicinity of water plants, prodigious quantities of all kinds may be easily procured; so that possessing, as we do, such myriads of them all around us, that they almost impregnate every thing that we eat and drink, touch and breathe, an anxiety to know more about them, and the effects they produce, cannot but be regarded as natural and laudable.

(Continued on page [illegible].)

OIL PAINTING.

(Resumed from page 317.)

Second Painting, or Second Stage.—The second painting begins with laying on the smallest quantity of poppy oil, then wiping it almost all off with a dry piece of a silk handkerchief.

The second painting is also divided into two parts: one, the first lay of the second painting, which is scumbling the lights, and glazing the shadows—the other, finishing the complexion with the virgin tints, and improving as far as you can without daubing.

First.—Scumbling is going over the lights where they are to be changed, with the light red tints, or some other of their own colors, such as will always clear and improve the complexion, with short stiff pencils, but such parts only as require it, otherwise the beauty of the first painting will be spoiled.

The light red tint improved is the best color for scumbling and improving the complexion. In general, where the shadows and drawing are to be corrected, you should do it with the shade tint, by driving the color very stiff and bare, that you may the easier re-touch and change it with the finishing tints. Some parts of the shadows should be glazed with some of the transparent shadow colors, such as will improve and come very near to the life; but be sure not to lay on too much of it, for fear of losing the hue of the first painting, the ground of which should always appear through the glazing. Be very careful in uniting the lights and shades, that they do not mix dead and mealy, for the more the lights mix with the shades the more mealy those shades will appear. Thus far the complexion is prepared and improved, in order to receive the virgin tints.

Second.—Go over the complexion with the virgin tints. These are the colors which also improve the coloring to the greatest perfection, both in the lights and shadows. Leave the tints and their grounds clear and distinct, and whilst the work is safe and unsullied leave what is further required for the next sitting; for in attempting the finishing touches before the other is dry you will lose the spirit and drawing, and your colors will become of a dirty hue.

Third Painting or Finishing.—It is to be supposed the complexion now wants very little more than a few light touches, therefore there will be no occasion for oiling.

Begin with correcting all the glazing first where the glazing serves as a ground or under part—then determine what should be done next before you do it, so that you may be able to make the alteration on the part with one stroke of the pencil. By this method you preserve both the glazing and the tints, but if it happens that you cannot lay such a variety of tints and finishing colors as you intended, it is much better to leave off while the work is safe and in good order, because those few touches, which would endanger the beauty of the coloring, may easily be done, if you have patience to stay till the colors are dry, and then without oiling add those finishings with free light strokes of the pencil.

Rembrandt touched up his best pictures a great number of times, letting them dry between. It was this method which gave them their surprising force and spirit. It is much easier to soften the over-strong tints when they are dry than when they are wet because you may add the very colors that are wanting, without endangering the dry work.

PAINTING DRAPERIES.

The right method of painting draperies in general is to make out the whole or first lay with three colors only, viz. the light, middle tint, and shade tint.

Observe that the light should rather incline to a warmish hue, and the middle tint should be made of friendly working colors. The shade tint should be made of the same colors as the middle tint, only with less light. The beauty and character of the folds, and the principal lights and shades are made with these three colors only.

The reflections of draperies and satins are generally productions of their own, and are always lighter than the shadows on which they are found, and being produced by light will consequently have a light warm color mixed with the local color that receives them.

In the first lay the lights should be laid with ple[illegible] stiff colo[illegible] and the [illegible] d and softened into character with the middle tint very correctly. Next make out all the parts of the shadows with the tint driven bare. After this comes the middle tint for the several lights and gradations, which should be very nicely wrought-up to character, without touching any of the high lights which finish the first lay.

Before we proceed to particular colors, it will be proper to make some observations on their grounds. It often happens that the color of the cloth is very improper for the ground of the drapery, and when it is [illegible] you should cha[illegible] th[illegible] colo[illegible] which are most proper to improve and support the finishing colors. This method of dead coloring must preserve them in the greatest lustre. In dead coloring you should lay the lights and shades in a manner so as only to show a faint idea of them, with regard to the shape and roundings of the figure.—These should be mixed and broke in a tender manner, and then softened with a large tool, so that nothing rough and uneven is left to interrupt or hurt the character of the finishing color.

White Satin.—All white should be painted on white grounds, laid with a good body of color—because this color sinks more into the ground than any other.

There are four degrees of colors on the first lay to white satin. The first is the fine white for the lights—the second is the first tint, which is made of fine white and a little ivory black. The middle tint should be made of white, black, and a little Indian red. The shade tint should be made of the same color as the middle tint, but with less white, so that it is dark enough for the shadows in general, with which to make out all the parts of the shadows nicely to character, which is the work of the first lay. Next follow the reflects and finishing tints.

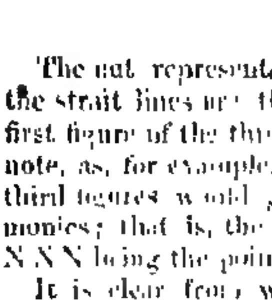
(Continued on page 371.)

ACOUSTICS.

(Resumed from page 325.)

M. SAVART, so well known for the number and beauty of his researches in acoustics, has proved that a high note of a given intensity being heard by some ears, and not by others, must not be attributed to its pitch, but to its feebleness. His experiments, and those more recently made by Professor Wheatstone, show, that if the pulses could be rendered sufficiently powerful, it would be difficult to fix a limit to human hearing at either end of the scale. M. Savart had a wheel made about 9 inches in diameter, with 360 teeth set at equal distances round its rim, so that while in motion each tooth successively hit on a piece of card. The tone increased in pitch with the rapidity of the rotation, and was very pure when the number of strokes did not exceed three or four thousand in a second, but beyond that it became feeble and indistinct. With a wheel of a larg[illegible] size, a much higher tone [illegible] be obtained, be[illegible], the teeth being wider apart, the blows were more intense, and more separated from one another. With 720 teeth on a wheel 32 inches in diameter, the sound produced by 12,000 strokes in a second was audible, which corresponds to 24,000 vibrations of a mu[illegible]al chord. So that the human ear can apprecia[illegible] a sound which only lasts the 24,000th part of a se[illegible]ond. This note was distinctly heard by M. Savart, and by several persons who were present, which convinced him, that with another apparatus, still more acute sounds might [illegible] and[illegible]

[illegible] *[illegible]ration of Strings.*—A string or wire strete[illegible] [illegible]ween two pins, when drawn aside and sudden[illegible] go, will vibrate till its own rigidity and the resistance of the [illegible] duce it to [illegible] The [illegible] oscillations may be [illegible] every pla[illegible] fined to one plane [illegible] the moti[illegible] ommunicated. In th[illegible] where the strings are st[illegible] by a hammer at one extremity, the vibrations [illegible] consist of a bulge running to and fro, from [illegible] end. Different modes of vibration may be o[illegible] from the same sonorous body. Suppose a [illegible] string to give [illegible] of the pi[illegible] etc, is the fund[illegible]ental note of the [illegible] lightly touc[illegible] exactly in the mid[illegible] the point at [illegible]st, each half will [illegible] as fast as [illegible] be [illegible] the [illegible] above [illegible] and the [illegible] When a point at a third of the [illegible] is kept at rest, the vibration will [illegible] last as those of the whole string, [illegible] twelfth ab[illegible] C. When [illegible] fourth of [illegible] whole, the [illegible] tions [illegible] times as f[illegible] se of [illegible] will give [illegible] the oct[illegible] acute soun[illegible] mental no[illegible]



The cut represents musical [illegible] ngs in vibration; the strait lines are the strings when at rest. The first figure of the three would give the fundamental note, as, for example, the low C. The second and third figures would give the first and second harmonics; that is, the octave and the 12th above C, N N N being the points of rest.

It is clear from what has been stated, that the string, thus vibrating, could not give these harmonics spontaneously unless it divided itself at its aliquot parts into two, three, four, or more segments in opposite states of vibration, separated by points actually at rest. In proof of this, pieces of paper placed on the string at the half, third, fourth, or other aliquot points, according to the corresponding harmonic sound, will remain on it during its vibration, but will instantly fly off from any of

the intermediate points. The points of rest, called the nodal points of the string, are a mere consequence of the law of interferences. For if a rope fastened at one end, be moved to and fro at the other extremity, so as to transmit a succession of equal waves along it, they will be successively reflected when they arrive at the other end of the rope by the fixed point, and, in returning, they will occasionally interfere with the advancing waves;—and, as these opposite undulations will, at certain points, destroy one another, the point of the rope in which this happens will remain at rest. Thus series of nodes and ventral segments will be produced, whose number will depend upon the tension and the frequency of the alternate motions communicated to the moveable end. So, when a string, fixed at both ends, is put in motion by a sudden blow at any point of it, the primitive impulse divides itself into two pulses running opposite ways which are each totally reflected at the extremities, and, running back again along the whole length, are again reflected back at the other ends. And thus they will continue to run backwards and forwards, crossing one another at each traverse, and occasionally interfering so as to produce nodes; so that the motion of a string, fastened at both ends, consists of a wave or pulse, continually doubled back on itself by reflection at the fixed extremities.

Harmonics generally co-exist with the fundamental sound in the same vibrating body. If one of the lowest strings of the piano-forte be struck; an attentive ear will not only hear the fundamental note, but will detect all the others sounding along with it, though with less and less intensity as their pitch becomes higher. According to the law of co-existing undulations, the whole string and each of its aliquot parts are in different and independent states of vibration at the same time; and, as all the resulting notes are heard simultaneously, not only the air, but the ear also, vibrates in unison with each at the same instant.

Harmony consists in an agreeable combination of sounds. When two cords perform their vibrations in the same time, they are in unison. But when their vibrations are so related as to have a common period after a few oscillations, they produce concord. Thus, where the vibrations of two strings bear a very simple relation to each other, as where one of them makes two, three, four, &c. vibrations in the time the other makes one; or if it accomplishes three, four, &c. vibrations while the other makes two, the result is a concord, which is the more perfect the shorter the common period. In discords, on the contrary, the beats are distinctly audible, which produces a disagreeable and harsh effect, because the vibrations do not bear a simple relation to one another, as where one of two strings makes eight vibrations while the other accomplishes fifteen.

Vibration in Pipes.—A blast of air passing over the open end of a tube, as over the reeds in Pan's pipes; over a hole in one side, as in the flute; or through the apertura called a reed, with a flexible tongue, as in the clarionet, puts the internal column of air into longitudinal vibrations by the alternate condensations and rarefactions of its particles. At the same time the column spontaneously divides itself into nodes, between which the air also vibrates longitudinally, but with a rapidity inversely proportional to the length of the divisions, giving the fundamental note or one of its harmonics.

A pipe, either open or shut at both ends, when sounded, vibrates entire, or divides itself spontaneously into two, three, four, &c. segments, separated by nodes. The whole column gives the fundamental note by waves or vibrations of the same length with the pipe. The first harmonic is produced by waves half as long as the tube, the second harmonic by waves a third as long, and so on. The harmonic segments in an open and shut pipe are the same in number, but differently placed. In a shut pipe the two ends are nodes, but in an open pipe, there is half a segment at each extremity, because the air, at these points, is neither rarefied nor condensed, being in contact with that which is external. If one of the ends of the open pipe be closed, its fundamental note will be an octave lower, the air will now divide itself into three, five, seven, &c. segments; and the wave producing its fundamental note will be twice as long as the pipe, so that it will be doubled back. All these notes may be produced separately, by varying the intensity of the blast. Blowing steadily and gently, the fundamental note will sound; when the force of the blast is increased, the note will all at once start up an octave; when the intensity of the wind is augmented, the twelfth will be heard, and by continuing to increase the force of the blast, the other harmonics may be obtained, but no force of wind will produce a note intermediate between these. The harmonics of a flute may be obtained in this manner, from the lowest C or D upwards, without altering the fingering, merely by increasing the intensity of the blast, and altering the form of the lips. Pipes of the same dimensions, whether of lead, glass, or wood, give the same tone as to pitch under the same circumstances, which shows that the air alone produces the sound.

(Continued on page 351)

ON BURNISHING.

To burnish an article is to polish it, by removing the small eminences or roughnesses upon its surface; and the instrument by which it is performed is denominated a *burnisher*. This mode of polishing is the most expeditious, and gives the greatest lustre to a polished body. It is made use of by gold and silversmiths, cutlers, locksmiths, and most of the workmen in gold, silver, copper, iron, or steel. It removes the marks left by the emery, putty of tin, or other polishing materials; and gives to the burnished articles a black lustre, resembling that of looking-glass.

The burnisher is an instrument, the form and construction of which is extremely variable, according to the respective trades; and it must be even adapted to the various kinds of work in the same art. In general, as this tool is only intended to efface inequalities, whatever substance the burnisher is made of is of little consequence to the article burnished, provided only, that it be of a harder substance than that article.

We shall first describe the art of burnishing silver articles, and afterwards point out the variety of modes in which the burnisher is used in other arts.

When silver articles have received their last fashion from the silversmith's hands, that is to say, when they have been worked, soldered, repaired, or adjusted, they are sent to the burnisher, who has the care of finishing them. He must begin by cleaning off any kind of dirt which their surfaces had contracted whilst making, as that would en-

tirely spoil the perfection of the burnishing. For this purpose, the workman takes pumice-stone powder, and with a brush, made very wet in strong soap-suds, he rubs rather hard the various parts of his work, even those parts which are to remain dull; and which, nevertheless, receive a beautiful white appearance. He then wipes it with an old linen cloth, and proceeds to the burnishing.

The burnishers used for this pupose, are of two kinds, some of steel, other of hard stone. They are either curved or straight; rounded or pointed; and made so as to suit the projecting parts, or the hollow of the piece.

Stone burnishers are made of blood-stone *(hæmatite)* cut, and either rounded with the grind-stone or rubbed, so that they present, at the bottom, a very blunt edge, or sometimes a rounded surface. These are polished with emery, like steel burnishers, and are finished by being rubbed upon a leather, covered with *crocus martis*. The stone is mounted in a wooden handle, and firmly fixed by means of a copper ferule, which encircles both the stone and the wood. The best blood-stones are those which contain the most iron, and which, when polished, present a steel color.

The operation of burnishing is very simple:—It is only requisite to take hold of the tool very near to the ferule or the stone, and lean very hard with it on those parts which are to be burnished, causing it to glide by a backward and forward movement, without taking it off the piece. When it is requisite that the hand should pass over a large surface at once, without losing its point of support on the work-bench, the workman, in taking hold of the burnisher, must be careful to place it just underneath his little finger. By this means the work is done quicker and the tool is more solidly fixed in the hand.

During the whole process, the tool must be continually moistened with black soap-suds. The water with which it is frequently wetted, causes it to glide more easily over the work, prevents it from heating, and facilitates its action. The black soap, containing more alkali than the common soap, acts with greater strength in cleansing off any greasiness which might still remain on the surface; it also more readily detaches the spots which would spoil the beauty of the burnishing.

In consequence of the friction, the burnisher soon loses its bite, and slips over the surface of the article, as if it were oily. In order to restore its action, it must be rubbed, from time to time, on the leather. The leather is fixed on a piece of hard wood, with shallow furrows along it. There are generally two leathers—one made of sole-leather, and the other of buff-leather. The first is impregnated with a little oil and *crocus martis*, and is particularly used for the blood-stone burnishers; the other has only a little putty of tin, scattered in the furrows, and is intended exclusively for rubbing steel burnishers, as they are not so hard as the blood-stones.

Blood-stone being very hard, the workman uses it whenever he can, in preference to the steel burnisher. It is, therefore, only in small articles, and in difficult places, that the steel burnishers are used; as they, by their variety of form, are adapted to all kinds of work. But, in general, the blood-stone greatly reduces the labor.

When the articles, on account of their minuteness, or from any other cause, cannot be conveniently held in the hand, they are fixed in a convenient frame on the bench; but, under all circumstances, the workman must be very careful to manage the burnisher, so as to leave untouched those parts of the work which are intended to remain dull. When, in burnishing any article, which is plated or lined with silver, he perceives any place where the layer of precious metal is removed, he restores it by silvering these places with a composition supplied by the silverer, which he applies with a brush, rubbing the part well, and wiping it afterwards with an old linen cloth.

The burnishing being finished, it only remains to remove the soap-suds which still adhere to the surface of the work; this is effected by rubbing it with a piece of old linen cloth, which preserves to it all its polish, and gives so great a lustre that the eye can scarcely bear to look upon it. But when the workman has a great number of small pieces to finish, he prefers throwing them into soap-suds, and drying them afterwards with sawdust which is more expeditious.

The burnishers of articles which are not silver, follow nearly the same process as that above described. We shall briefly notice the variations to be observed in each case.

The burnishing of gold-leaf or silver, on wood, is performed with burnishers made of wolves or dogs teeth, or agates, mounted in iron or wooden handles. When they burnish gold, applied on other metals, they dip the blood-stone burnisher into vinegar; this kind being exclusively used for that porpose. But when they burnish leaf-gold on prepared surfaces of wood, they are very careful to keep the stone, or tooth, perfectly dry. The burnisher used by leather-gilders is a hard polished stone, mounted in a wooden handle: this is to sleek or smooth the leather.

The ordinary engraver's burnisher is a blade of steel, made thin at one end, to fit into a small handle, which serves to hold it by. The part in the middle of the blade is rounded on the convex side, and is also a little curved. The rounded part must be well polished, and the tool be very hard.

They use this burnisher to give the last polish to such parts of copper and steel plates as may have been accidentally scratched, or specked, where false lines are to be removed, and also to lighten in a small degree such parts as have been too deeply etched or graved.

In clock-making, they burnish those pieces or parts which, on account of their size or form, cannot be conveniently polished. The burnishers are of various forms and sizes; they are all made of cast steel, very hard, and well polished; some are formed like the sage leaf files, others like common files: the first are used to burnish screws, and pieces of brass; the others are used for flat pieces. The clock-makers have also very small ones of this kind, to burnish their pivots: they are called *pivot-burnishers*.

The burnishing of pewter articles is done after the work has been turned, or finished off with a scraper: the burnishers are of different kinds, for burnishing articles either by hand, or in the lathe; they are all of steel, and while in use are rubbed with putty powder on leather, and moistened with soap-suds.

The burnishing of cutlery is executed by means of hand, or vice burnishers; they are all made of fine steel, hardened, and well polished. The first kind have nothing particular in their construction; but the vice-burnishers are formed and mounted

... different manner. On a long piece of wood, placed horizontally in ... ... is fixed another piece, as long, but bent in the ..., the concavity of which is turned downwards. These two pieces are united at one of their extremities by a pin and hook, which allows the upper piece to move freely around this point as a centre. The burnisher is fixed in the middle of this ... piece, and it is made more or less projecting, by the greater or lesser length which is given to its base. The moveable piece of wood, at the extremity opposite to the hook, is furnished with a handle, which serves the workman as a lever. This position allows the burnisher to rest with greater force against the article to be burnished, which is placed on the fixed piece of wood. They give to the burnisher, either the form of the face of a round-headed hammer, well polished to burnish those pieces which are plain or convex; or the form of two cones, opposed at their summits, with their bases rounded, to burnish those pieces which are concave or ring-shaped.

The burnishing of the edges of books is performed with a wolf's or dog's tooth, or a steel burnisher; for this purpose they place the books in a screw press, with boards on each side of them, and other boards distributed between each volume;—they first rub the edges well with the tooth, to give them the lustre. After sprinkling or staining, and when the edges are become dry, they first burnish the front; then turning the press, they burnish the edges at the top and bottom of the volume.

They burnish the gilt edges in the same manner, after having applied the gold; but observe in gilding, to lay the gold first upon the front, and allow it to dry; and, on no account, to commence burnishing till it is quite dry.

MISCELLANIES.

New Species of Cotton.—A specimen of a peculiar kind of cotton, the growth of Columbia, has been recently exhibited at Havannah. It was obtained near Bogota, and is said to be of an extremely soft and perfect silky texture, and glossy appearance, of a short staple and dingy color. It grows on a tree of considerable height, different from our plant. The cotton grows round the seed, in something like the shape of a pine-apple, so that when picked it ... ... The Indians ... it into ... ... a quantity has been ... to ... ... purpose of ascertaining whether it cannot be incorporated into the manufacture of silk goods.

Indian Rubber Tubes.—A bottle of Indian rubber, previously softened by boiling in water, is first ... ... the ... possible extent, by means of a ... ... The rubber, thus ... into a ... ... layer, is then cut ... ... of one or two inches, and wrapped ... round polished iron rods, of the ... as the bore of the ... ... a hole through each ... a tube ... to one hole, ... in a ... manner, over the ... ... gum ... The whole ... in water ... perfect ... with fresh ... is complete. ...

... the ... surface of the ... ... by ... ... boiling ... ... in ... to be distinguished ... ... from the ... ... in commerce.

Discovery of Galvanism.—The discovery of the effects of electricity ... animals took place, at the time, from something like accident. ... Galvani, at that time professor of anatomy in the university of Bologna, ... health, employed, as a ... ... the custom of the country, ... of frogs. A number of these animals ... for the purpose of cooking, were ... with that comfortable negligence common to both French and Italians, which allows them without repugnance to do every thing in every place that is at the moment most convenient, in the professor's laboratory, near an electrical machine, it being probably the intention of the lady to cook them there. While the machine was in action, an attendant happened to touch, with the point of the scalpel, the crural nerve of one of the frogs, that was not far from the prime conductor, when the limbs were instantly thrown into strong convulsions. This experiment was performed in the absence of the professor, but it was noticed by the lady, who was much struck by the appearance, and communicated it to her husband. He repeated the experiment, varied it in different ways, and perceived that the convulsions only took place when a spark was drawn from the prime conductor, while the nerve was at the same time touched with a substance which was a conductor of electricity.

Animal Temperature.—By a series of experiments continued daily, except in rough weather, and, on a few other occasions, from April, 1836, to Nov. 6, 1837, on ten men of La Bonite, during her voyage round the world, it appears that the heat of the human body rises or falls with like changes in the external atmosphere. It rises slowly in passing from a hot to a cold clime; it rises more rapidly in the contrary passage; but it is more marked in some individuals than in others. The same men exhibited, however, only a single degree of cent. difference under a change of 40° of external temperature; that is, at Cape Horn, when the temperature was 0° cent., and in the Ganges, near Calcutta, where the air was 40° cent.

QUERIES.

155—How are steel pens browned or bronzed? *Answered on page* 413.

156—Why does friction produce free electricity? *Answered on page* 413.

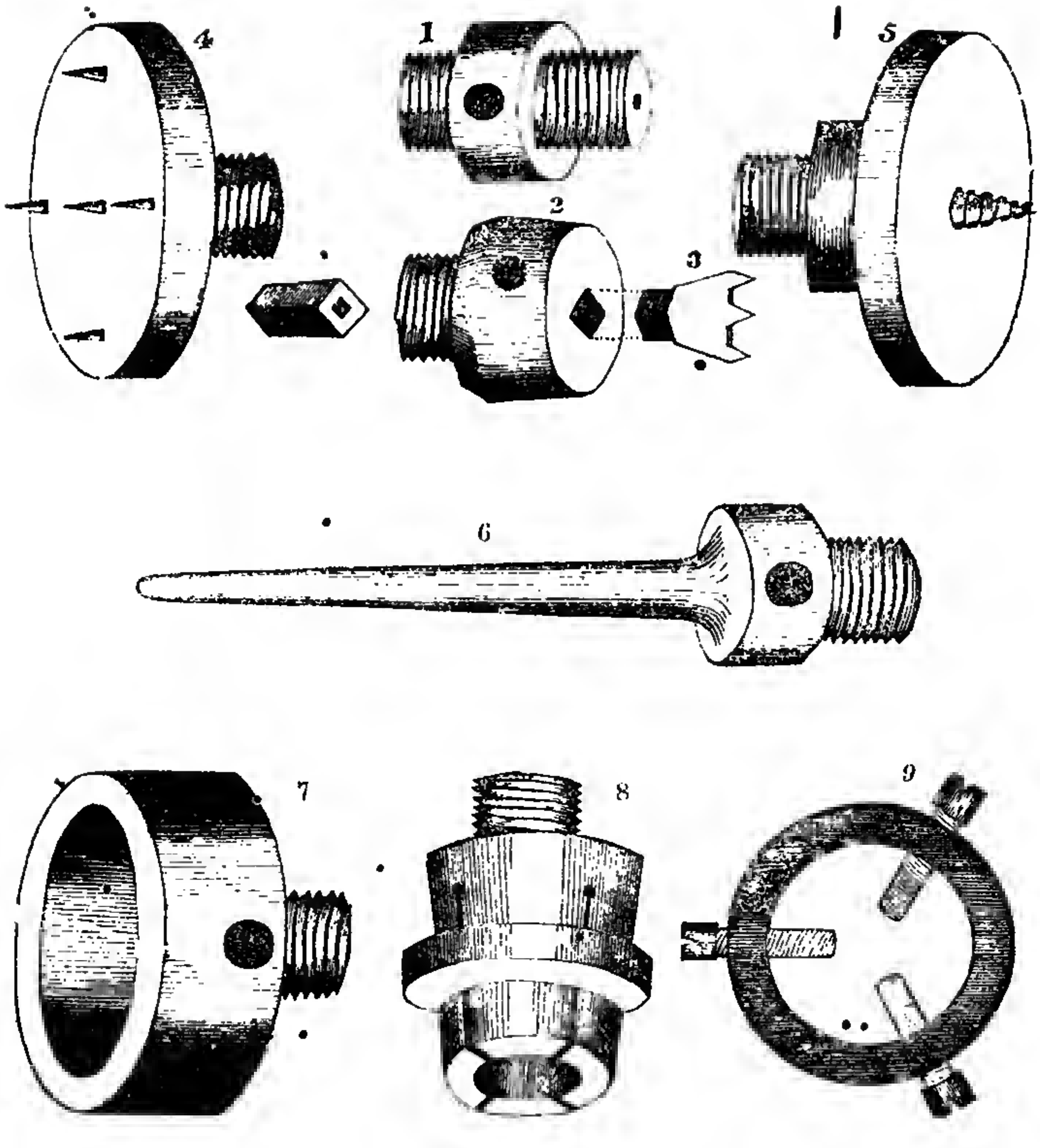
157—Mineral marmoretum; how is this substance prepared? *Answered on page* 380.

158—What is the composition used by dentists to take model of the mouth? *Answered on page* 380.

159—How ... ... rendered semi-opaque, so as to resemble ... ... how made in ... ... 416.

... ... prepared? *An...*

...



APPENDAGES TO THE LATHE.

CHUCKS.

A PERSON possessing a lathe, and desiring to fix any material for the purpose of turning it into a regular form, employs for that purpose a small apparatus, called *a chuck*. Under this general term, therefore, is included all those tools which serve to connect the material to be operated upon, be it wood, stone, ivory, or metal, to the mandril of the lathe.

Chucks are called by general names, according to the substance which forms them, as wood chucks, brass chucks, &c.; and by particular names, according to their form, and the particular purpose for which they are intended. It will be at once evident, that as the art of turning produces such an endless variety of forms, and is applied to such numerous purposes, the chucks that would be adapted to hold tightly one object would be quite inapplicable to another, and this without reference to size, or hardness of material worked upon, though these must by the turner be also taken into his account.

Chucks may, with propriety, be divided into two classes: one class consisting of simple chucks, or such as being fixed to the mandril of a lathe are capable only of communicating motion around a determined axis, such as they themselves receive; in consequence of which the wood, &c., fastened to them acquires a certain rotatory motion, and a cutting tool held against it removes only the parts which are equally distant from that axis. This being the case, all bodies turned, when fixed by a simple chuck, assume a round form; a section of them at any part shows a circular disk, and all the ornaments which the turner may have thought proper to place upon them, extend wholly round the circumference, at right angles to their centre of motion. Also if such bodies be cut exactly in half longitudinally, the one half will precisely correspond with the other.* Of such nature as this are most of the objects commonly made by the turner—such as cylinders, spindles, legs for articles of furniture, balls, handles, rings, knobs, and a thousand other articles, or parts of articles.

The second class of chucks is of such a character that the axis of the work can be changed as the operator pleases, so as to throw the centre of motion to any point, and to make the work revolve round any given axis. In consequence of this an endless variety of beautiful forms is produced, and which cannot even be attempted by the common chuck. This is particularly the case with surface turning: that is, rendering a flat, or nearly flat surface ornamental, by means of the lathe, and which has added much to the beauty of watch cases, and engraved checks, &c., for bankers. According to the nature of this ornamental work, the chucks which produce it are called the eccentric chuck, the oval chuck, the segment engine, the geometric chuck, &c. We shall endeavour to illustrate the whole of these in turn; at present it is necessary to confine our attention to those of a more simple character, not only because the common turner, but the engine and eccentric turner equally employ them, not merely to roughly cut the wood, &c., previously to using the complicated chucks, but in conjunction with them.

Before making chucks for our own use, the character of the nose of the mandril is to be observed; if it have a *female* screw, that is, a hollow screw, it will be necessary that all the chucks to fit it should have a corresponding *he* screw, such as are represented as belonging to all the figures given; but to cut these screws is not always an easy operation for the young turner, nor are they so convenient as those which are themselves furnished with a hollow screw. To make this screw is the first requisite, and it is usually done by drilling a hole, of proper size, and screwing into it a tap, prepared for the purpose, which cuts a thread as it proceeds. It is evident that, to unite this with the mandril, a connecting piece is necessary—such a one is represented in Fig. 1, where are seen two screws, one of which fastens into the mandril, the other into the chuck. A shoulder is left between them, that each may be steadied, and a hole is cut into the shoulder sideways, in order to put a short lever in it when it is screwed up or loosened.

* It is necessary to notice an apparent exception to this general description, in favor of screws, and also of water cocks, and perhaps a few other articles; but the thread of screws is formed by altering the position of the tool, and water cocks by suddenly stopping the mandril, so that the tool cuts but half round.

The *Square-hole Chuck* is represented in Fig. 2. It is of the first necessity for the turner—the square hole is of such a size as to fit all the usual bits and larger drills. It is well adapted to hold large wires, or such other things as may be cut to a square plug at one end. Often a square plug is made to use with it, having a still smaller hole in its centre for smaller drills and wires—two or three forked ends are usually furnished to it, such as that represented in Fig. 3—the obvious use of which is to hold long pieces of wood, their teeth being driven into the end of the wood. The square of the fork is inserted into the square-hole chuck, while the other end of the wood rests upon the point of the back poppit. When furnished with these forks it is called the *Fork Chuck*.

The *Flanch Chuck*, (Fig. 4,) is made similar in size and general appearance to the next, except that instead of the screw in the centre, it is provided with five points, as shown. The flat piece of wood which is to be turned must be driven upon it, until the points are forced in sufficiently to hold tight. It may be used with the back poppit, when it becomes of the nature of the fork chuck, or else it may serve to hold a flat surface, without reference to any other support; but then it will be observed, that the points hold but slightly, and that any knot in the wood, or jar of the tool, would loosen its hold. It is never used but for wood

The *Screw Chuck*, (Fig. 5.) This consists of a flat disk of metal or wood, about 2 inches over, with a tapering screw projecting about half an inch forwards from the centre. It is used chiefly to fasten flat pieces of wood which are to be turned only upon one surface, [illegible] example making flat stands or supports for [illegible] thing. It is exceedingly convenient for this reason, that the work is screwed tightly and firmly to the face of the chuck; and if it should be necessary to [illegible]move it from the lathe, before the turning of it [illegible] finished, it may be replaced again without error. It will, however, not bear much strain, and is w[illegible]y inapplicable to fixing plates of metal. Wh[illegible] this chuck is used the back poppit is taken away.

The *Cement* or *Pitch Chuck*, is the same as the last would be without its screw, work is fastened to it by rubbing upon it a piece of pitch, or shoemaker's wax, which is still better. The friction occasioned by the chuck revolving rapidly, when the pitch is held against it, detaches a portion, on account of the warmth caused by the friction. When a disk of wood is to be fastened to it, it is only necessary to hold the wood against the chuck when revolving—when the same cause, which at first detached the pitch, will occasion the material to be operated upon to adhere pretty strongly. The chuck is used chiefly to hold flat pieces of ivory, bone, horn, wood, or metal, when its surface is to be polished, or ornamented by delicate and small lines or indentures.

The *Arbor Chuck*, (Fig. 6,) is next in order, as in importance. It consists merely of a round rod of metal, with a screw which fastens into the mandril. The turner must have arbor chucks of every size, from one-eighth of an inch upwards to an inch or more in diameter. They are valuable in fixing rings, hollow cylinders, tubes, pulleys, beads, &c., where the two surfaces are required to be perfectly true with each other.

The *Cup Chuck* or *Plain Chuck*, (Fig. 7.) is formed of a hollow cup of metal. It is used by driving into it a piece of wood, and cutting this off

flat with the front surface. When any thing is to be turned, it may either be driven tightly into the chuck without its plugging, or else a hole may be turned in it, of a size adapted to hold the particular object to be operated upon. It may be used with or without the back puppit, as circumstances may require. It holds very firmly, and is of very general application.

The *Wire Chuck* or *Spring Chuck*. These are but two names for the same article. It is formed merely of a thick, round, short piece of brass, drilled with a small hole for some distance through the centre, and cut downwards with a saw as far as the hole extends. It is used chiefly for the turning of wires, which to be fastened are only driven into the hole, when the firmness and yet elasticity of the brass holds them sufficiently tight, and with no time lost in adjustment.

The *Ring Chuck*, (Fig. 8.) This is of the same character as the last; but is made of box-wood, has a larger hole, and two or more saw cuts down it, instead of one. As this is to hold larger objects, the strain is of course greater than with those which lie so near the centre as wires do, it is therefore necessary to bind the parts together with a stout ring of metal. Fix the wood in it thus:—Take off the ring, fit the wood into the cavity moderately tight, then putting the metal ring over the chuck, (which is made slightly tapering,) give it three or four gentle knocks around—thus fixing the whole together immoveably.

The *Die Chuck*, the front view of which is shown in Fig. 9, is of exactly the same general form as the cup chuck, but rather more shallow. It differs more materially, however, in having three, four, or six screws passing through its sides, and meeting towards the centre. By the points of these screws the work is held, the screws being adjusted so that the work is well centered. It is used chiefly in turning metallic cylinders, &c.

(Continued on page 402.)

FORMING LENSES AND SPECULA FOR TELESCOPES, &c.

A GOOD composition for the specula of reflectors is one of the most important desiderata in the making of telescopes. The qualities most in request are, a sound uniform metal, free from all microscopic pores; not liable to tarnish by absorption of moisture from the atmosphere; not so hard as to be incapable of taking a good figure and exquisite polish, or so soft as to be easily scratched; and possessing a high reflective power. The various compositions employed for specula differ more in the admixture of minor ingredients than in their essential materials. Copper and tin (bronze metal) are the metals mostly employed, with small quantities of arsenic, silver, and brass. The proportions generally employed are, copper 32 parts, grain tin 15, with the addition of . parts of arsenic to render it more white and compact. The Rev. Mr. Edwards, in a treatise annexed to the "Nautical Almanac," for 1787, says, that if 1 of brass and 1 of silver be used with only 1 of arsenic, a most excellent metal will be obtained, which is whiter, harder, and more reflective than any other he ever met with. With respect to the practical value of this composition we can speak, but having made specula for reflecting instruments ourselves, we can vouch for the goodness of the following, both with respect to the exquisite figure and polish it is capable of assuming, and its freedom from pores. To make this composition, take 2 parts of copper, as pure as it is possible to be procured; (for the goodness of the speculum will depend on the purity of the materials employed,) this must be melted in a crucible by itself; then put in another crucible, 1 part of pure grain tin. When they are both melted, mix and stir them with a wooden spatula, keeping a good flux on the melted surface to prevent oxidation: this metal must be quickly poured into the moulds, which may be made of founders' loom; the intended face always being downwards. Where the speculum is required particularly good, the best mode of casting it is to have an iron mould made with a vertical tube attached on one side, and the bottom of the tube to end in a bulb; the melted metal is then to be poured down the tube, and will fill the bulb and mould, leaving a sufficiency in the tube to give pressure. The bulb being lower than the mould will retain any dense impurities, and the tube the lighter ones, while the speculum will be uniform and dense.

Having thus procured the speculum, the next thing will be to grind it to the required figure; this is effected on a convex brass or hard metal circular tool, carefully turned to a gauge of the required curve. This tool is fixed on a post or upright, and the speculum is held in the hand by means of a convenient holder cemented on its back. The grinding is then commenced with coarse emery-powder and water, when the roughness is taken off by moving the speculum across the tool in different directions walking round the post: fine emery is used in the same way, till the surface of the speculum has become uniform. The next step will be to smooth it by means of fine washed flower emery, gradually passing from one degree to the next finer, and washing the tool and speculum between each application of emery, to prevent any gritty particles from scratching the metal. When the speculum is completed, and of the required figure, it is next to be polished. This is done by taking a convex tool similar to the grinder, or the grinder itself, and covering it with pure pitch, evenly spread over its surface; while warm a concave tool of the same figure as the speculum is then worked over its surface wet. When the proper figure is obtained, washed putty, (*i. e.* combined oxyde of tin and lead) is poured on the pitch, and the speculum polished thereon by moving it as before. During the process of grinding and polishing, the tools must be carefully examined by the *gauge*, and if they happen to get out of the true figure, the speculum must be worked more on the edge, or middle, as the case may require. Instead of the vertical *post* above mentioned, a *lap* is sometimes employed, which produces a much better figure and more expeditiously. A lap consists of a common lathe communicating a slow and regular motion to a vertical mandrel, on which the grinding or polishing tool is fixed; in using the lap the artist is enabled to stand in the same place, and has more command over the work.

Lenses are ground precisely in the same manner as specula, but the polishing is different. Here the concave or convex polishing tool is made of brass, and when turned of a proper curve, a smooth thick piece of felt (cloth) is stretched over the tool and cemented to it; the outer surface is then imbedded with washed putty powder. After this is done, the lens, or block of lenses, is worked on

it with cross motions; if the powder be employed too wet the fibres of the cloth will rise up, and polish not only the surface, but also the small hollows left in the grinding. This effect, from the nature of the polishing surface being heterogeneous, generally takes place to a greater or less extent when viewed by a microscope; these cavities being polished admit the light and disperse it, instead of it being collected as with a uniform surface. When these faults are visible to the eye, the lens is called *curdled*. If we are desirous of procuring an uniform and perfect surface, the polishing tool must be homogeneous, and the best material for its foundation is good clean *bees' wax*, hardened by the addition of *red sulphate of iron*, dry and finely washed. This composition when of the proper temper is melted over the brass tool; and when cold can be turned to the required curve. The advantage of this improvement, besides its uniformity is, that should any hard scratching particles insinuate themselves between the tool and glasses, they sink and are imbedded in the wax, and thus their injurious effects are prevented. The polish of lenses made in this manner is clear and defined when examined by a microscope; when the shadow of a bar is brought across them. This method is now employed by one of the first opticians in the metropolis.

Centering of Lenses.—The centering of lenses for accurate instruments is of great importance, more especially for the object glasses of achromatic telescopes. Different opticians employ their own methods, but one of the best is done by reflection: let the lens to be centred be cemented to a brass chuck, having the middle turned away so as not to touch the lens, but near the edge, which will be hid when mounted; this rim is very accurately turned flat where it is to touch the glass. When the chuck and cement is warm it is made to revolve rapidly: while in motion a lighted candle is brought before it and its reflected image attentively watched. If this image has any motion, the lens is not flat or central: a piece of soft wood must therefore be applied to it in the manner of a turning tool, till such time as the light becomes stationary. When the whole has cooled, the edges of the lense must be turned by a diamond, or ground with emery. This method of centering and adjusting object-glasses by their reflected images, was laid before the public by Dr. Wollaston, and has been used by our first opticians for a considerable time.

MAKING ARTIFICIAL MAGNETS.

(Resumed from page 307.)

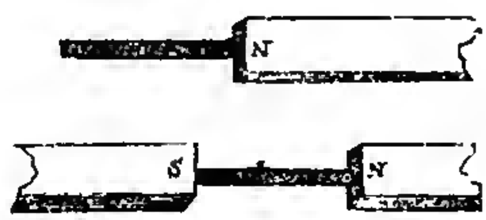
The last paper considered the method of making magnets without the aid of others. The present begins that division of the subject in which it is supposed that we are already furnished with a magnet, and by the assistance of which we are desirous of making others.

By Single Touch.—The simplest method of magnetizing a bar of hard steel, (and none other will retain the magnetism given to it so long,) is by placing it on a table as near as possible in the magnetic meridian; that is, nearly north and south—and holding over it perpendicularly a strong bar magnet, rubbing it throughout its whole length, begining at one end, and passing it along to the other—pressing it somewhat during its passage. After reaching the end of the steel bar, the magnet must be lifted up, and applied again to the other end, and so on for several times, the friction being always made in the same direction.

Fig. 1.

By Contact.—Another method consists in placing the end of a small bar of steel, in contact with one of the ends of a powerful bar magnet, and striking the new bar so as to make it ring during the time of its application. This method, however, will like the first only be efficacious for small bars. A better method is to place the unmagnetized bar between the opposite poles of two strong magnetic bars of equal power. In this case, the magnetism of the new bar will be nearly twice as strong as when only one is used. The following cut shows both these methods. The smaller being the newly made magnet. N signifies the north, and S the south pole, in this and every following example.

Fig. 2.



Dr. Knight's Method.—This gentleman, a physician of London, was long celebrated for the excellence of the artificial magnets he made. The method he used was kept a secret during his life, but was published after his death by Mr. Wilson. The bar which he intended to magnetize was placed under the opposite poles of two equal magnets. These magnets are then separated in opposite directions, so that the south pole of the one passes over the north polar half of the bar to be magnetized, and the north pole of the other over its south polar half. This operation is repeated several times, till the magnetism of the under bar is fully developed.

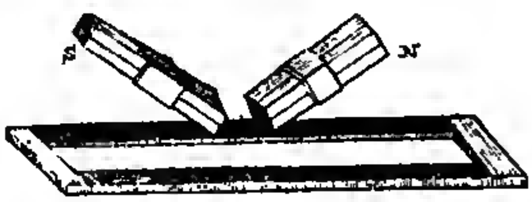
Fig. 3.

N | S

Duhamel's Method.—When Mr. Knight's process was applied to large bars it was found to be defective, which induced M. Duhamel to try the method represented in Fig. 4. The bars to be magnetized are placed parallel to each other, and have their extremities united by two pieces of soft iron, at right angles to the bars. Then take two strong magnets, or two bundles of small bar magnets, the bars of each bundle having their similar poles together, and place them as in the figure, at an angle of about 90 degrees, or inclined 45 degrees each, to one of the bars, having the north pole of the one bundle downwards, and the south pole of the other bundle. They are then separated from each other by drawing them along the under bar to its extremities. The same operation is to be repeated on the other bar, and continued alternately on both, till their full magnetic powers are supposed to be developed. When the magnets are placed upon the second bar, the disposition of the poles is to be reversed—the pole that was at first in the

right hand being now placed in the left. The two bars are then to he turned with their lower face uppermost, and the operation repeated several times, as before.

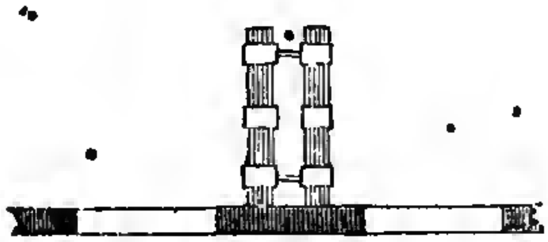
Fig. 4.



The distinctive property of M. Duhamel's process is the employment of the connecting pieces of iron, and in the use of bundles of small bars, which are more efficacious than two single ones of the same size. This method is applicable to curved bars, or those of a horse-shoe form.

Mr. Mitchell's Method; or the Method of Double Touch.—Having joined together, at the distance of a quarter of an inch, two bundles of strong magnetized bars, their opposite poles being together, he placed five or more equal steel bars in the same straight line, and resting the extremity of the bundles of magnets upon the middle of the centre bar, (see Fig. 5.)—he moved them *backwards* and *forwards*, throughout the whole length of the line of bars, repeating the operation on each side of the bars, till the greatest possible effect was produced. Mitchell states, that two magnets will, by his process of double touch, communicate as strong a magnetic virtue to a steel bar as a single magnet of five times the strength, when used in the process of single touch.

Fig. 5.



(*Continued on page* 373.)

RED-CHALK CRAYONS.

The red-chalk crayon and its uses are too well known in daily life, to require anything to be said of them. The preparation of those red crayons which are best adapted for drawing, however, is less known. The following is the manner in which it is performed:—A quantity of *hematite* is ground in a porphyry mortar, with filtered water, until it be extremely divided, so as to form an impalpable powder. This powder is again diffused in a quantity of water sufficient to allow finer parts of the mixture to be passed through a fine sieve, placed above a large vessel filled with water. The liquid holding the hematite in suspension is then agitated; and after this allowed to rest four and twenty hours. At the end of this time, there is formed at the bottom of the vessel a deposit of hematite, in the form of a very fine powder: the water is cautiously decanted from it.

To form crayons of this impalpable powder, a uniting medium is necessary. This is afforded either by gum arabic or isinglass, of which the proportions vary, according to the use to which the crayon is destined; less of it being required for soft crayons, which, consequently, yield their color more readily; and more for the hard ones, which preserve their points longer. The following are the proportions, reduced from experiments, to be employed in the five kinds of crayons which we shall describe:

1. For the soft red crayons, which leave broad traces, 18 grains of dry gum arabic, to 1 ounce of the prepared hematite powder.
2. For harder crayons, 21 grains of gum, to 1 ounce of the hematite powder.
3. For still harder crayons, and which make small and delicate marks, 22 grains of gum to 1 ounce of hematite.
4. For the hardest of this kind 27 grains of gum to 1 ounce of hematite.
5. For crayons which leave shining traces, 36 grains of isinglass to 1 ounce of the prepared hematite powder.

The gum or isinglass is to be dissolved separately in a sufficient quantity of water, and their solutions passed through a linen cloth; the hematite powder is then added. The liquid is brought near to a gentle fire, until the mass is somewhat thickened by the evaporation of the water, when it is to be removed from the fire. The mixture is then to be carefully ground on a porphory slab to render it as intimate as possible, and is ready to be formed into crayons. To effect this, the mass, when it has become of a proper consistence, is forced through a cylinder: the sticks thus formed, are dried, and divided into crayons, of two inches long. They are then sharpened at their points; and the hard crust, which had formed upon them while drying, is removed.

CHEMICAL ACTION.

If, when two different substances are mixed together, they have no tendency to unite, and their constituent principles remain unchanged, they are said to have no affinity for each other, and their union is mechanical; but when the properties of either or both become changed, the mixture is chemical, or in other words they are said to have been chemically combined, in consequence of an attraction or affinity that there exists between them.

Ex. 1.—*Chalk and Water unite mechanically.*—Put some pounded chalk in a glass of water; stir it up, and it will soon settle unchanged at the bottom of the glass again—the mixture being mechanical.

Ex. 2.—*Chalk and Vinegar unite chemically.*—Instead of the glass of water, substitute a glass of vinegar, and immediately the chalk is put in it they will unite together, and form a chemical compound different in its nature from either the chalk or vinegar used.

Ex. 3.—*Oil and Water a mechanical mixture.*—Mix together oil and water in a phial; however much these may be shaken together the action is merely mechanical, as will be seen by their soon separating—the oil resting upon the top of the water as at first.

Ex. 4.—*Soap a chemical compound.*—Add to the oil and water, a little pearl-ash or potass: shake the phial as before, and the three will unite chemically, forming soap.

Ex. 5.—*The Phial of the Four Elements*, as it is called, is an example of mechanical action. It is made thus:—Take a phial, about 6 or 7 inches long, and about ¾ of an inch in diameter. In this

phial put, first, iron or copper filings; secondly, chalk or whiting; next, water; and, lastly, naphtha. These being of different densities, and having no chemical affinity for each other, will soon settle as at first, however much the vessel may be shaken.

Ex. 6.—*Chemical union of Four Bodies.*—Instead of the naphtha, pour gently into the phial nitric acid. It will be seen to unite chemically with the metal, the chalk, and the water, making the whole a blueish homogeneous mass.

ITS DEGREE AND DURATION.

The degree of chemical action exercised by bodies upon each other is exceedingly varied, and so also is the time requisite for that action to take place. In some instances many days or even weeks and years pass away, before its effects become visible. In the spontaneous decay of animals and vegetables—the disintegration of rocks—the oxidation of iron—and still more so of lead and copper, by contact with the air, all of which are chemical processes, show the slow and gradual progress of chemical action. While the varied effects of effervescence, combustion, and explosion, illustrate how suddenly chemical action sometimes proceeds. The effect produced is often but little removed from a mere mechanical operation, and the change of properties inconsiderable: thus it is in solutions and decoctions. At other times it is impossible to recognize the components in the compound produced from them. Bodies have often an affinity for each other in one state, though not in another; frequently the admixture of a third body is requisite to promote their union. In most instances, increase of temperature greatly aids chemical action, even light is frequently productive of the same effect; and in all cases it is absolutely necessary that each body should be in a state of minute division: thus two solids combine with difficulty—a solid and fluid more easily—and two fluids with yet greater facility.

Ex. 7.—*Slow Action of the Atmosphere upon Iron.*—Let a piece of brightened iron lay exposed to the weather, if wet it will soon be rusted, if dry some considerable time will elapse before this takes place.

Ex. 8.—*Gradual absorption of Water by Lime.*—Quick lime left exposed to the air becomes gradually slaked or chemically united with water, by depriving the atmosphere of any moisture which may be suspended in it.

Ex. 9.—*Gradual change caused by Fermentation.* Mix a pound of raw sugar with a gallon of water; in a few days a fermentation will ensue, which will change the whole into vinegar.

Ex. 10.—*Chemical effect of Light.*—Wash a piece of paper over with a strong solution of nitrate of silver; dry it in the dark, and when dry expose it to the sun's light; though colorless before it will now soon become black. The effect will be much more rapid, if the paper be first dipped in very weak salt and water, it will then be photogenic paper, and a picture may be made by placing a dried plant, feather, bit of lace, &c., upon it, previous to its exposure to light.

Ex. 11.—*Rapid chemical action shown by Effervescence.*—Add to a glass of sour beer, vinegar, or lemon juice, a little carbonate of soda, effervescence immediately ensues, and the acidity of the liquid is destroyed.

Ex. 12.—*Rapid chemical action shown by Combustion.*—Let fall into the flame of a candle some filings of iron or zinc, they will immediately burn—throwing out most beautiful scintillations.

Ex. 13.—*Rapid chemical action shown by Explosion.*—Place a crystal of nitrate of ammonia in a fire shovel over the fire; when it has arrived at a heat sufficient for melting lead, it will in the act of decomposition explode with considerable violence.

Ex. 14.—*Intense action shown by Solution.*—Put some filings of copper or tin in a glass, and pour upon them a little nitric acid, when a rapid dissolving of the tin will take place, on account of the affinity between it and the acid—a nitrate of tin being formed.

Ex. 15.—*Combustion of Nitrate of Copper.*—Wrap up some crystals of nitrate of copper in tin foil, while dry no chemical union takes place, but moisten them with water, and soon the whole bursts into flame.

Ex. 16.—*Formation of Sulphuret of Iron.*—Hold a roll of sulphur to a bar of cold iron, they remain without uniting; but bring the iron bar to a red heat, and apply the sulphur as before, it will now unite with the iron, rendering it extremely brittle, while a considerable portion of light and heat will be extricated—the iron being changed into the sulphuret.

Ex. 17.—*Formation of Glass.*—Mix together sand and potass; while cold no change is apparent, but heat them with the flame of a candle, urged with a blow-pipe, or else in the fire, and they will unite and form glass.

Ex. 18.—*Brilliant Combustion of Chlorate of Potass.*—Shake together some pieces of sulphur and crystals of chlorate of potass—no action takes place; pound them in a mortar, and a loud snapping noise, attended by a flash of light, will announce their union. [*Caution.*—This should be tried in very small quantities.]

Ex. 19.—Mix together loaf sugar and chlorate of potass: of themselves they do not chemically combine, but touch them with a drop of sulphuric acid, and a most vivid combustion will ensue.

Ex. 20.—*Extemporaneous Soda Water.*—Mix together half a tea spoonful each of the dry powders of carbonate of soda and tartaric acid; in this state they have no chemical affinity for each other, but dissolve each previously in water, and the union of the two solutions will be attended by violent ebullition; in fact, the mixture is the well-known saline draught, or soda water.

ITS EFFECT.

Chemical action alters not merely the nature of bodies, but very frequently their form also, as may be seen by many of the preceding experiments: thus solids are sometimes formed from gases and from liquids—liquids from solids and gases—and gases themselves are invariably produced from either one or other of these distinct classes. It is productive also, in many instances, of great alterations of temperature, of volume and specific gravity, of color, and of taste.

Ex. 21.—*Two Gases form a Solid.*—Brush the inside of a tumbler with a feather dipped in hydrochloric acid, and another with liquid ammonia; if now one tumbler be inverted over the other, the two invisible gasses which are emitted unite and form an opaque solid, which is the chloride of ammonia or sal ammoniac. It will appear in the glasses as white fumes.

Ex. 22.—*Two Liquids form a Solid.*—Put into a glass a few spoonsful of a saturated solution of

chloride of lime, (muriate of lime,) and add to it gradually, drop by drop, sulphuric acid. If these two liquids be stirred together with a glass rod, they become converted into an opaque, white, and almost solid mass.

Ex. 23.—*Two Solids form a Liquid.*—Put into a mortar 2 drams of sulphate of soda and 2 drams of nitrate of ammonia. These substances when rubbed together will gradually become fluid.

Ex. 24.—*Two Liquids vaporized by Mixture.*—Pour upon some strong spirits of wine an equal quantity of fuming nitrous acid, the chemical action will be so energetic that the whole will be dissipated into vapor.

Ex. 25.—*Two Gases form a Liquid.*—Mix together chlorine and carburetted hydrogen gases. They will unite, and form an oily-looking liquid.

Ex. 26.—*Two Gases form a Liquid.*—Mix together oxygen and hydrogen gases, in the proportion of 2 parts of the latter to 1 of oxygen, in a bladder. Blow a soap bubble with the mixed gases, and when risen away from the bladder set fire to it, and the chemical union of the contained gases will be attended with a loud report, and water be formed.

Ex. 27.—*Two Gases unite, and still remain gaseous.*—Mix together equal quantities of chlorine gas and hydrogen gas. They will when subjected to light unite and form another gas, the chloric or muriatic acid gas: it may be collected in a liquid state, by placing a little water in the vessel holding the two gases.

Ex. 28.—*A Gas formed from a Solid.*—Subject a piece of marble to a red heat in a fire, and carbonic acid gas will be given off in abundance. The marble being changed at the same time into quicklime.

Ex. 29.—Fill the bowl of a common tobacco-pipe with coal dust, cover it with sand or clay, and place it in the fire; when hot, carburetted hydrogen gas will be evolved, and may be lighted at the end of the stem of the pipe.

Ex. 30.—Partly fill a phial with some syrup of loaf sugar, which will be perfectly colorless, and add to it some strong sulphuric acid, also colorless; shaking up this mixture, a black powder will be deposited, which is the carbon of the sugar.

Ex. 31.—Make a solution of sulphate of copper, so weak as to be colorless, and add to it a little liquid ammonia. It will change immediately to a most delightful blue.

GRECIAN OR PERSIAN PAINTING.

This description of painting is very easy of attainment, (being taught in three lessons,) and to those who have even but a very slight knowledge of drawing, the following instructions will most likely be found all that is requisite to succeed in this style. It is done on a particular kind of paper with powder colors, which are mixed together dry, and rubbed on in the same state with the finger, taking no heed of doors, windows, &c., which are scraped out afterwards with a pen knife. This style of coloring, when finished, looks very like a well and softly-executed chalk drawing, and is very appropriate for landscapes, particularly ruins. The materials required are as follows:—

First.—A sheet of Grecian paper: it is covered with a chalky substance, resembling that on visiting cards, but with this difference, that the surface is rather rough, and of a yellowish white color, and has a peculiar scent, something like oil cloth.

Second.—The following colors in powder.—Constant white, ivory black, Vandyke brown, Italian pink, yellow ochre, chrome yellow, Indian yellow, mazarine blue, cobalt blue, crimson lake, Indian red, and vermillion.

Third.—The following chalks, (Contés)—Two shades of light green, one bright yellow, one yellowish white stone color, one grey, one light brown, and one hard and one soft black.

Fourth.—Make a varnish to set the drawing of picked mastic, two grains; and spirits of wine, one ounce.

Fifth.—A little sepia in lump, and the following:—A brush, such as is used for a small tooth comb, a pen knife, a camel-hair pencil, a stumper, and three or four little cups or jars, to mix the colors in. Pill boxes answer very well to keep the colors in. Prints will do for copies but they must be done on a much larger scale in the painting, and the coloring must be according to subsequent directions.

The outline of the buildings and trees are to be sketched with the hard black conté, taking no notice of doors, windows, or other minutiæ. Then mix your colors.

Sky.—Cobalt blue and white, sometimes a little black for the clouds, but sparingly.

Buildings.—Yellow ochre and white, or Vandyke brown, and white shade with black.

Roofs and Chimneys.—Vermillion, shaded with Indian red or black.

Trees.—Mazarine blue, black, and Indian yellow—the high lights with chrome yellow. They should be painted dark as the foliage, (which is done with green contés,) renders them lighter. The stems should be done with the brown conté, and shaded with the black soft one.

Ground.—Vandyke brown and white, shaded with neutral tint, which is made with Indian red, and very little mazarine blue. Italian pink may be used for sandy ground, as also green for that covered with herbage.

Water.—Mazarine blue and white, shaded with black. Foam and the high lights are produced by scraping off the colors with a knife.

The lighter parts are all produced by adding a little white. After the colors are rubbed in with the finger, the drawing to be occasionally outlined with the black conté—the lights are then to be removed with the knife, (doors, windows, &c., the same way.) The varnish is then to be laid on by putting a few drops on the brush, and splashing the drawing all over, by drawing the finger on the hairs of the brush. It may then be touched up with a little sepia, or other water color, as the subject may require, but the water color is not necessary, as the proper effect can always be produced by using the colored contés.

The crimson lake is used for drapery, warm tints in the sky, &c. The stumper for working off the color when laid on too dark. a.

MOSAIC WORK OF THE ITALIANS,

As described by Mr. Ferber, in his "Letters upon the Mineralogy and Natural History of Italy."

A.D. 1771.

The people of modern Rome have preserved an art practised by their ancestors, and of which there yet exist specimens among the beauteous relics of antiquity. I speak of the mosaic. The ancients used to combine natural stones with glass and other

artificial substances employed in the work, but the modern mosaic is composed of glass alone. The glass is first cut into strips, with the diamond, and then broken into small cubes of diverse sizes; these pieces are of innumerable colors and shades, and they are placed in separate cases. A flag of lime stone is then chosen, and having smoothed one side of it, the workmen cover it with an adhesive cement made of quick lime, powder of Travertino stone and linseed oil; this cement must be spread evenly on the flag, about three inches in thickness, and left until it becomes somewhat firm and dry.

The outlines of the figures to be worked are drawn upon the surface of the cement, and also upon paper, to guide the artist in the delineation of the picture. The cubes of glass before mentioned being pointed at one end, are placed conveniently to the artist's hand, in their separate cases. He selects them according to the size, color, and quantity that the drawing before him demands; these cubes are then driven piece by piece, in juxta position to one another, with an edged hammer into the cement, until the whole surface of the picture is filled up, or, if I may use the word, *paved*, according to the taste of the artist. When this is done, and when the cement is quite dry, the surface, (now somewhat uneven) is polished with fine sand and tripoli, and afterwards with emery made into a paste, rubbing over the surface with a plate of lead. When the polishing process has been completed, the interstices of the cubes are filled up with wax of the same color, taking care to scrape off, with a sharp knife, any that may rest upon the surface, and thus tarnish it.

The stone upon which this mosaic work rests, may be cut like any other to the requisite dimensions and thickness. It is easy to see that the tediousness of the work renders it expensive, and when the cubes of glass are small, the work is of necessity more troublesome and dear, but in this case it is much more beautiful. There is a mosaic laboratory attached to St. Peter's, where artists are employed chiefly in decorating this superb edifice. They place mosaic pictures at all its altars, and these are equal to any paintings in design, in elegance, and in harmony of color.

As time does not injure the mosaic, it has served to immortalize the best painters, and although one cannot blend the colors so intimately in mosaic work as with the pencil, yet the defect is supplied by an endless variety of shade in the glass, nor should the glare of the work be objected to, when we remember that in looking upon a mosaic picture, there is, as with a painting, a particular point of view, from which the design can be observed without offending the eye.

IMPRESSIONS OF LEAVES.

To the Editor.

Sir.—Having seen, in page 256 of your excellant Magazine, a method of taking impressions of leaves, I have sent a few specimens of impressions taken by myself by an old, but I think simple process. The way I proceed is this:—

Take a piece of good letter paper, and smear it over with olive oil on one side; it is then hung up by one corner for two or three days; it is next to be blackened by the smoke of a tallow candle on the side that was oiled, taking care that you do not scorch it; then place a fresh leaf, with the upper side or face on the blackened oil paper, covering it with another piece of soft paper, and smoothing it over with the hand, using gentle pressure. The leaf must then be placed carefully on a piece of clean white paper, covered over, and rubbed, as before, for a short time, when you will find that it has made a beautiful impression on the paper below. The oiled paper must be smoked each time that you take an impression—the leaves should be fresh gathered. I think the advantages of this plan are very evident, there being nothing required when you have your paper oiled, but a common candle to smoke it, and an impression may be taken in a few minutes.

Haverfordwest, Jan. 20, 1840. H. E. Z.

PROCESS FOR INK DEVOID OF FREE ACID.

BY R. HARE, M.D.,

Professor of Chemistry in the University of Pennsylvania

Writing ink is usually constituted of the tanno-gallate of iron, and a portion of sulphuric acid, which had existed in the copperas or sulphate of iron employed as one of its ingredients, the tanno-gallate being suspended and the acid dissolved in water. This free acid is injurious to iron pens. Dr. Hare has observed that when an infusion of galls is kept over finery cinder till saturated, it forms a beautiful ink, in which, of course, there is no free acid.

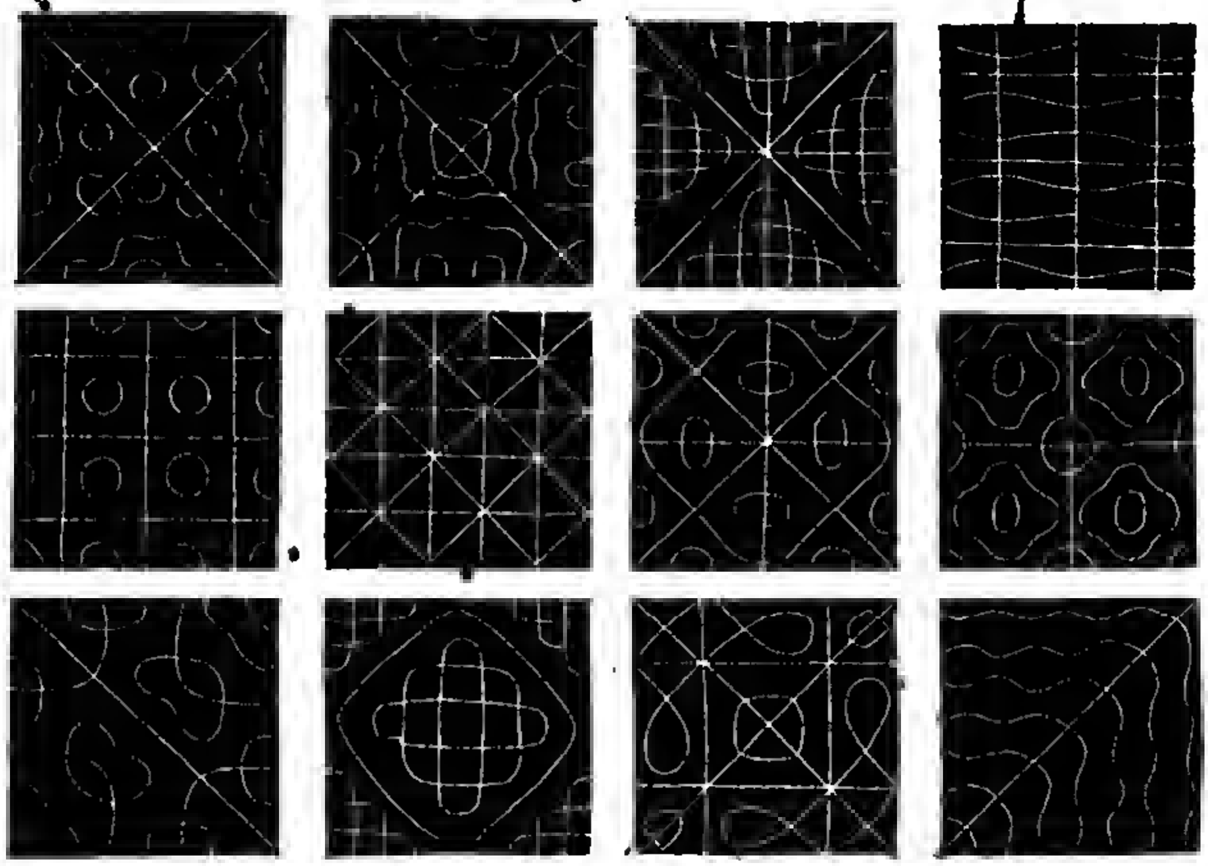
This ink is rather more prone to precipitate than that made with sulphate of iron, and this propensity is not counteracted by the addition of gum arabic. But, on the other hand, it has the advantage of being easily suspended again by agitation, not forming any concrete matter insusceptible, like common ink grounds, of that distribution in water which is necessary to good ink. The tanno-gallate of iron, when obtained from a filtered infusion of galls and finery cinder, as above described, on being evaporated to the consistency of thick molasses, gum arabic in due proportion having been previously added, forms a pigment which might, it is conceived, supersede Indian ink. When completely dried it glistens like jet with or without the gum.

This tanno-gallate of iron only requires to be dried and ignited at a low red heat, in order to be converted into a pyrophorus. A few years ago, Dr. Hare ascertained that, by a similar ignition in close vessels, cyano-ferrite of iron, the Prussian blue of commerce, gave a pyrophorus. But as the pure cyano-ferrite of iron, resulting from the addition of the ferro-prussiate of potash, more properly the cyano-ferrite of potassium, to a ferruginous solution did not form a pyrophorus; he was led to believe that the presence of sulphate of alumine in the commercial Prussian blue was the source of the difference, probably by being converted into a sulphate of aluminium, or potassium.

The production of a pyrophorus from the tanno-gallate proves that iron and carbon, when in a state of minute division, are capable, by ignition in close vessels, of acquiring that property of spontaneous combustibility which entitles the body which possesses it to be called a pyrophorus.

In truth, these results are consistent with some facts mentioned by Berzelius, as having been ascertained by Mitcherlich, respecting the spontaneous combustibility of iron, reduced from the state of magnetic oxide to that of the pure metal in an extreme state of division. They are also consistent with the spontaneous combustibility of the residue resulting from the ignition of the oxalate of iron at a red heat.—*Philosophical Magazine.*

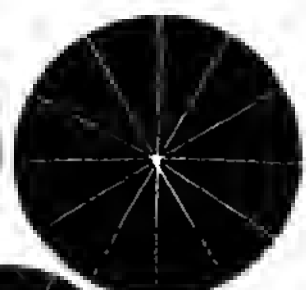
Fig. 1.



ACOUSTICS—CHLADNI'S FIGURES.

3.

2.



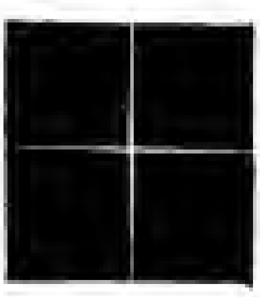
4.

8.

ACOUSTICS.

(Resumed from page 341 and concluded.)

Vibration of Springs and Discs.—A glass or metallic rod, when struck at one end, or rubbed in the direction of its length with a wet finger, vibrates longitudinally, like a column of air, by the alternate condensation and expansion of its constituent particles, producing a clear and beautiful musical note of a high pitch, on account of the rapidity with which these substances transmits sound. Rods, surfaces, and, in general, all undulating bodies, resolve themselves into nodes. But, in surfaces, the parts which remain at rest during their vibrations are lines, which are curved or plane according to the substance, its form, and the mode of vibration. If a little fine dry sand be strewed over the surface of a plate of glass or metal, and if undulations be excited by drawing the bow of a violin across its edge, it will emit a musical sound, and the sand will immediately arrange itself in the nodal lines, where alone it will accumulate and remain at rest, because the segments of the surface on each side will be in different states of vibration, the one being elevated while the other is depressed, and as these two motions meet in the nodal lines, they neutralise one another. These lines vary in form and position with the part where the bow is drawn across, and the point by which the plate is held. The motion of the sand shows in what direction the vibrations take place. If they be perpendicular to the surface, the sand will be violently tossed up and down, till it finds the points of rest. If they be tangential, the sand will only creep along the surface to the nodal lines. Sometimes the undulations are oblique, or compounded of both the preceding. If a bow be drawn across one of the angles of a square plate of glass or metal held firmly by the centre, the sand will arrange itself in two straight lines parallel to the sides of the plate, and crossing in the centre, so as to divide it into four equal squares, whose motions will be contrary to each other. Two of the diagonal squares will make their excursions on one side of the plate, while the other two make their vibrations on the other side of it. This mode of vibration produces the lowest tone of the plates.



If the plate be still held by the centre, and the bow applied to the middle of one of the sides, the vibrations will be more rapid, and the tone will be a fifth higher than in the preceding case; now the sand will arrange itself from corner to corner, and will divide the plate into four equal triangles, each pair of which will make their excursions on opposite sides of the plate. The nodal lines and pitch vary not only with the point where the bow is applied but with the point by which the plate is held, which being at rest, necessarily determines the direction of one of the quiescent lines. The forms assumed by the sand in square plates are very numerous, corresponding to all the various modes of vibration.

The lines in circular plates are ever more remarkable for their symmetry, and upon them the forms assumed by the sand may be classed in three systems. The first is the diametrical system, in which the figures consist of diameters dividing the circumference of the plate into equal parts, each of which is in a different state of vibration from those adjacent. Two diameters, for example, crossing at right angles, divide the circumference into four equal parts; three diameters divide it into six equal parts; four divide it into eight, and so on. (fig. 2.) In a metallic plate, these divisions may amount to thirty-six or forty. The next is the concentric system, where the sand arranges itself in circles, having the same centre with the plate; (fig. 3,) and the third is the compound system, where the figures assumed by the sand are compounded of the other two, producing very complicated and beautiful forms, (fig. 4.)

Galileo seems to have been the first to notice the points of rest and motion in the sounding board of a musical instrument; but to Chladni is due the whole discovery of the symmetrical forms of the nodal lines in vibrating plates. Our principal cut of the present Number contains a few of Chladni's figures. The white lines are the forms assumed by the sand, from different nodes of vibration, corresponding to musical notes of different degrees of pitch.

Professor Wheatstone has shown, in a paper read before the Royal Society, in 1833, that all Chladni's figures, and indeed all the nodal figures of vibrating surfaces, result from very simple modes of vibration, oscillating isochronously, and superposed upon each other; the resulting figure varying with the component modes of vibration, the number of the superpositions, and the angles at which they are superposed. For example, if a square plate be vibrating so as to make the sand arrange itself in straight lines parallel to one side of the plate, and if, in addition to this, such vibrations be excited as would have caused the sand to form in lines perpendicular to the first had the plate been at rest, the combined vibrations will make the sand form in lines from corner to corner.

M. Savart's experiments on the vibrations of flat glass rulers are highly interesting. Let a lamina of glass 27 in. ·56 long, 0·59 of an inch broad, and 0·06 of an inch in thickness, be held by the edges in the middle with its flat surface horizontal. If this surface be strewed with sand, and set in longitudinal vibration by rubbing its under surface with a wet cloth, the sand on the upper surface will arrange itself in lines parallel to the ends of the lamina, always in one or other of two systems. The long cross lines of fig. 6, show the two systems of nodal lines given by M. Savart's laminæ.

Fig. 6.

Fig. 7.

Although the same one of the two systems will always be produced by the same plate of glass, yet

among different plates of the preceding dimensions, even though cut from the same sheet side by side, one will invariably exhibit one system, and the other the other, without any visible reason for the difference. Now if the positions of these quiescent lines be marked on the upper surface, and if the plate be turned so that the lower surface becomes the upper one, the sand being strewed and vibrations excited as before, the nodal lines will still be parallel to the ends of the lamina, but their positions will be intermediate between those of the upper surface (fig. 7.) Thus it appears that all the motions of one half of the thickness of the lamina, or ruler, are exactly contrary to those of the corresponding points of the other half. If the thickness of the lamina be increased, the other dimensions remaining the same the sound will not vary, but the number of nodal lines will be less. When the breadth of the lamina exceeds the 0·6 of an inch, the nodal lines become curved, and are different on the two surfaces. A great variety of forms are produced by increasing the breadth and changing the form of the surface; but in all, it appears that the motions in one half of the thickness are opposed to those in the other half.

M. Savart also found, by placing small paper rings round a cylindrical tube or rod, so as to rest upon it at one point only, that when the tube or rod is continually turned on its axis in the same direction, the rings slide along during the vibrations, till they come to a quiescent point, where they rest. (fig. 8.) By thus tracing these nodal lines he discovered that they twist in a spiral or corkscrew round rods, and cylinders, making one or more turns according to the length; but at certain points, varying in number according to the mode of vibration of the rod, the screw stops, and recommences on the other side, though it is turned in a contrary direction; that is, on one side it is a right-handed screw, on the other a left. The nodal lines in the interior surface of the tube are perfectly similar to those in the exterior, but they occupy intermediate positions. If a small ivory ball be put within the tube, it will follow those nodal lines when the tube is made to revolve on its axis.

Fig. 8 gives the nodal lines on a cylinder, with the paper rings that mark the quiescent points.

In consequence of the facility with which the air communicates undulations, all the phenomena of vibrating plates may be exhibited by sand strewed on paper or parchment, stretched over a harmonica glass, or large bell-shaped tumbler. In order to give due tension to the paper or vellum, it must be wetted, stretched over the glass, gummed round the edges, allowed to dry, and varnished over to prevent changes in its tension from the humidity of the atmosphere. If a circular disc of glass be held concentrically over this apparatus, with its plane parallel to the surface of the paper, and set in vibration by drawing a bow across its edge, so as to make sand on its surface take any of Chladni's figures, the sand on the paper will assume the very same form, in consequence of the vibrations of the disc being communicated to the paper by the air. When the disc is removed slowly in a horizontal direction, the forms on the paper will correspond with those on the disc, till the distance is too great for the air to convey the vibrations. If the disc while vibrating be gradually more and more inclined to the horizon, the figures on the paper will vary by degrees; and when the vibrating disc is perpendicular to the horizon, the sand on the paper will form into straight lines parallel to the surface of the disc, by creeping along it instead of dancing up and down. If the disc be made to turn round its vertical diameter while vibrating, the nodal lines on the paper will revolve, and exactly follow the motion of the disc. It appears from this experiment that the motion of the aerial molecules in every part of a spherical wave, propagated from a vibrating body as a centre, are parallel to each other, and not divergent like the radii of a circle. When a slow air is played on a flute near this apparatus, each note calls up a particular form in the sand, which the next note effaces to establish its own. The motion of the sand will even detect sounds that are inaudible. By the vibrations of sand on a drum-head the beseiged have discovered the direction in which a counter-mine was working. M. Savart, who made these beautiful experiments, employed this apparatus to discover nodal lines in masses of air. He found that the air of a room, when thrown into undulations by the continued sound of an organ-pipe, or by any other means, divides itself into masses separated by nodal curves of double curvature, such as spirals, on each side of which the air is in opposite states of vibration. He even traced these quiescent lines going out at an open window, and for a considerable distance in the open air. The sand is violently agitated where the undulations of the air are greatest, and remains at rest in the nodal lines. M. Savart observed, that when he moved his head away from a quiescent line towards the right, the sound appeared to come from the right, and when he moved it towards the left, the sound seemed to come from the left, because the molecules of air are in different states of motion on each side of the quiescent line.

INTERNAL STRUCTURE OF PLANTS.

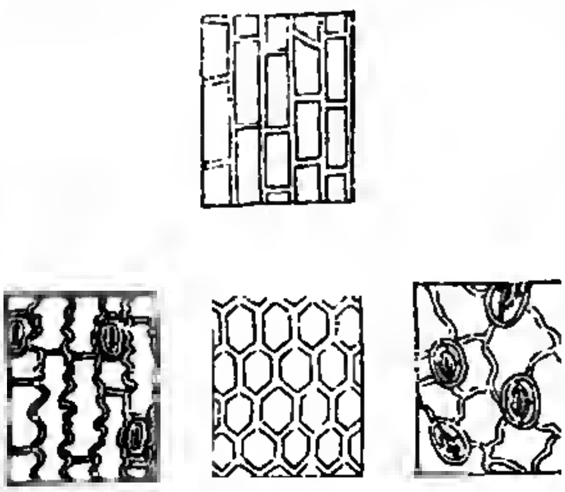
All vegetable substances consist of fluids and solids some of which are the food upon which plants subsist and the matters which they secrete. The others serve either to contain or convey the rest forward. This will be rendered plainer by treating of the more solid parts first: these consist of *membranes*, *cells*, and *fibres*. They are all represented in a common leaf, which, as is well-known to all, consists of an outer skin or membrane; next of a pulpy portion or cellular tissue; and within these of a mass of woody vessels or fibres. All these may be compared to skin, flesh, and bones, while throughout the whole, as in the animal body, are veins, vessels, and pores, through which a circulation of fluids is carried on, and in which certain chemical changes conducive to the life, growth, and health of the individual are continually taking place.

Membranes and their pores.—A thin skin covers every part of the vegetable organs, except the stigma. This increases with their growth, and is destroyed only by disease, injury, or the natural decay of the part which it covers. The membrane is intended for various purposes. First, as a defence and protection against atmospheric changes; and, secondly, as it exists in the colored parts of a plant, particularly in the leaves; as an instrument through which the vegetable breathing is carried on, and where various juices of plants are subjected to such an influence of light and warmth as to produce the chemical changes necessary for vegetable life. It is this organ also which enables the plant to benefit by absorbing moisture and gasses from the atmosphere, and throwing off such as are useless or redundant—this it does by means of pores, called

stomata, which ere more or less ebundant over its general surface.

To show the nature of the euticular membrane, we have only to tear off a part of the eovering of a leaf, and submit it to a moderete microscope. Thet which to the naked eye appears a fine, transparent, and even skin,* now that it is megnified; will be seen composed of meshes like net-work, of different shapes, according to the plant from which it may have been torn. It is also scattered over with various pores, which are the stometa formerly spoke of, while the net-work appearance erises from different vessels passing across the membrane in various, but certain directions.

The following shows several verieties of membrenous structure:—



1. Cuticle of the Spiderwort. 2. Ditto of the Indian Corn. 3. Ditto of the upper surface of the Hoya Carnosa. 4. Ditto of one of the Violets.

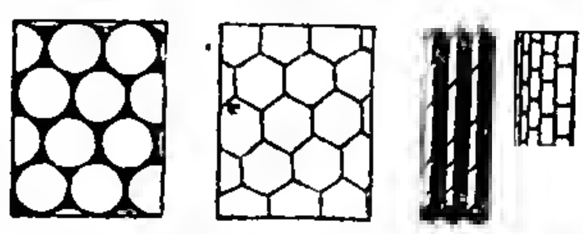
The size of the meshes of cuticles is extremely veried in different plants, always larger then the cells within, yet so minute thet more than 50,000 are sometimes found within the spece of e squnre inch. The stomste also sre somewhet different in form and eize, but vary still more in their abundance. On leaves always eovered with water none are discovereble, floating leaves have them only on their upper surface, and leaves wholly aerial have generally very many less upon their upper side than on their lower one, as appears from the following table:—

Number of pores upon various leaves on a square inch.

Names of the Plants.	Upper surface.	Lower do	On both
Alisma plantago........	12,000	.. 6,000	.. 18,000
Cobea scandens.......	oooe	.. 20,000	
Clove Pink...........	38,500	.. 38,500	.. 77,000
Common Mezerson ...	oooe	.. 4,000	
Hydrangea quercifolia .	oooe	.. 16,000	
Common House-leek .	10,710	.. 6,000	.. 16,710
Common Rhubarb ...	1,000	.. 40,000	
Spiderwort .	2,000	.. 2,000	.. 4,000
Misletoe	200	.. 200	.. 400

The difference of numbers seen in the above will be found to agree exactly with the repidity with which the leaves wither after being gathered, and revive again when wetted. Thus we know how long a branch of misletoe will remain without ite leaves drying up, while those of the Weter Lily and the Hydrangea fade almost immediately. Also when a shower of rain occurs after long drought, we must have witnessed that many plants revive long before the moisture can have arrived at their roots, and some much more repidly than others—the only absorbents acting in this case being the stomata upon the euticle.

Pulp or *cellular tissue.*—This consists of a number of bags, filled with air or more usually with verious juices, composing the whole substance of most of the eryptogamic plants, (therefore called cellular,) and all the softer parts of flowering vegetables, such as the pulp of fruit, the fleshy part of leaves, and the pith which fills the stem. To examine the cellular structure, we have only to cut e cross section of any common pulpy stem, and to view it in e drop of water under the microscope—it will be found to consist of variously-shaped cavities. If the stem be very loose and young, it will most often consist of circular spaces, (1,) with a cavity between each. If these be subject to e slight pressure, as they will be in a future growth of the plant, they will become twelve-sided, the intervening spaces having become smaller; and finally, by the pressure of each upon the others, they will become hexagonal, the anguler spaces, in the first instance so conspicuous, being wholly filled up, (2.) This appears to be the real cause of the different shapes observable in the above forms, of which the hexagon, more or less regular, is thst most commonly met with. A vertical section of a stem shows the cells to be mostly longer than their breadth, like eylinders or many-sided prisms, (3.) When the cellular tissue runs between the harder parts of plants, such as that which exists in the medullary rays of wood, it becomes pressed into nearly flat tubes, (4.) Cotton is cellular tissne in a dried state. It has been steted, that the cellular integuments are filled with air or various juices. These are chiefly water, occasionally flavored with various products, such as bitters, acids, &c. Sometimes the water is ebsent, and oils, gums, resins, starch, sugar, essences, mucilage, &c., takes its place in certain, if not all of the cells—mostly in those of the bark and leaves.



WOODY FIBRES.

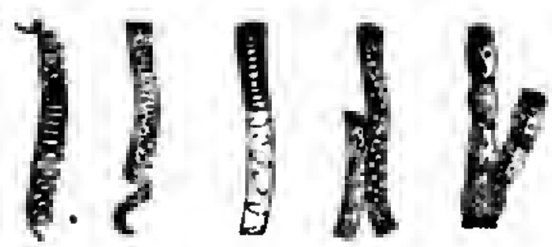
Distinguished from the abovs sre the hard and tough fibres, which forms the woody parts of plants, called therefore *woody tissue.* In many plants it does not exist—they sre therefore brittle, and when dead rot away in a short time. Where the woody tissue exist, in proportion to its quantity, so the plante are durable and strong—thue in the Hemp end the Flax, the fibres possess considereble strength add durability. In shape fibres of this kind vary but little, being long cylinders tapering towards either end—they are extremely fine, generally not one-fiftieth of the diameter of a human hair. They are always found in bundles of a considerable number united together, and every thread of Flax, however minute, is not a single fibre, but a bundle of numerous fibres interlacing each other.

The collection of various such bundles forms not only the wood of trees, but the hard coats and

* There are in reality two membranes covering the fleshy part of a leaf—the outer one, called EPIDERMIS, is so exceedingly fine as to be scarcely ever visible even with the best microscopes. It resembles more the pellicle of a soap bladder than any thing else—that described above as the cuticular membrane is to be considered the true cutis, or real skin.

shells of seeds—a considerable portion of the bark—the stones within fruit—the more solid parts of roots—the petioles, the ribs, and veins of leaves; also thorns, prickles, &c.; at the extremities of which it becomes of extreme hardness and fineness.

Sap and other vessels.—It is evident, that there must be channels of some kind or other in the stems, whereby the moisture absorbed by the roots may be conveyed to the extremities, and also to the central parts of plants submitted to the action of the air. These are called air and sap vessels, and exist in every part of a plant, which is not cellular tissue, (in this it is not wanted, as the cells are capable of absorbing moisture, and conveying it from one to another.) Thus in the pith we find no vessels of any kind, nor yet in the pulp of fruit, they not being wanted here—but the woody fibre is not so absorbent, and therefore is filled with vessels which run lengthways through it, and of these there is such a multitude, that more than 20,000 have been seen in a morsel of oak, about the twelfth of an inch square. These vessels, from the forms they usually assume, are called *spiral*, (1)—*reticulated*, (2)—*annular*, (3)—*punctured* (4)—and *beaded*, (5)—all of which convey fluids upwards, while there are straight bundles of tubes, called ducts, to convey them downwards.



1 2 3 4 5

The simple spiral.—If the leaf of a Vine tree, the fleshy scale of a bulb, or the leaf stalk of the Elder tree, or the Castor Oil plant, be broken cautiously, and the parts drawn asunder, the spiral vessels will be seen like screws, partially unrolled, and forming when in their contracted state a cylindrical tube. The fine fibre which is thus curiously rolled up is generally round and single, but instances occur in which it is evidently flattened and others in which four or more fibres are coiled together. They are exceedingly elastic, and of different sizes in different species. Spiral vessels are found in all perfect plants, except a few which are always submersed in water, and also in almost every part, in the veins of leaves, all the divisions of the flower, the lobes of the seed, and in the embryo, even from its first germination. It is not, however, to be supposed that the spiral vessels are equally abundant in every part, nor yet that they run indiscriminately through the whole substance of a stem. It has been already stated, that they are not found in the pith of trees, nor are they in the bark, and but rarely in the root. Their chief situation in ligneous plants is immediately around the pith in the centre, forming what is called the medullary sheath. Whether the use of the spirals be to convey air or water is not certain, but it is supposed the former, for which reason they are often called *tracheæ*, or breathing tubes.

The reticulated vessels appears to have been a simple spiral, but altered by parts of it having decayed away, or been broken through—a circumstance the more probable as reticulated vessels are found only in old plants. They are situated chiefly in the root in bundles, though existing in very few plants. The stem of the Balsam yields abundance of them: the situation is near the bark.

The annular vessel.—This is said by one botanist to be the only duct for the conveyance of sap upwards, but evidently in error, it being by no means common. It consists of a number of rings, often connected together so as to form a tube; at other times the rings are separate one from another, and connected by a fine membrane, which forms a tube around them. The annular vessel may easily be seen in the Spiderwort and the Balsam.

The punctured vessel seems intermediate with the spiral and annular vessels: it appears like a tube covered with oval-shaped dots, that are many of them porous. It is the largest of all the vegetable vessels, and nearest to the bark. It exists in the root, the wood of the stem, the leaf stalks, &c.

The beaded vessel resembles a chain of oblong beads: it is found only in the knots of stems and tubercles of the roots. Its use is scarcely known, and it is very doubtful whether the beaded vessel, any more then the punctured and the reticulated vessels, be any thing more then the simple spiral in a state of partial decay—an opinion the more plausible as those very situations, which in the first growth of a plant contain spirals, have, when it has become aged instead of these, the beaded or the punctured vessel.

[From a little work published by the Editor called "THE GRAMMAR OF BOTANY." Price 4s.]

TANNING

(Resumed from page 336, and concluded.)

By the Decoction of Bark, &c.—In 1804 a patent was granted for an improved method of tanning hides: viz., by immersing them in the liquor in which oak bark had been boiled. According to this improvement the Patentees filled a boiler of copper, (or any other metal that does not stain or color the liquor) half full, with ground bark, and poured water upon it, up to the brim. The whole is then boiled for three hours, till the tanning principle is completely extracted. The liquor is then suffered to run off by a cock into pits, where it stands to cool. The hides are now put into the liquor, and *handled* frequently, by taking them out and putting them in again, because the liquor is too powerful for them to remain long at a time, in the first stages of tanning. They are then to be removed to fresh liquors from time to time as the old is weakened, until the operation is complete. By this method a greater quantity of the tanning principle is collected into a small compass; less bark is consumed; and there is a great saving of labour.

If leather is required with a lighter color or bloom, a small quantity of the dust of bark is mixed with the liquor. By this method, hides that have been shaved in the baits may be better tanned in two or three weeks, and skins in ten or twelve days, than in the one case in nine months, and in the other in six months by the usual process.

Here the great advantage is that derived from extracting the tanning principle by means of boiling; as business to any extent may be carried on with about one-tenth part of the capital employed on the old plan.

Besides bark, the Patentees make use of oak chips, and oak saw-dust: they have succeeded

with the common heath or heather: and they find that the bark of most trees that produce *hard wood* has a tanning principle in them; but above all they recommend the young shoots from the roots of oaks, and the superfluous twigs or branches that may be lopt off, so as not to injure the trees. These when cut in proper season, may be chopped and ground, and boiled with bark, and will produce a stronger tanning liquor than bark from the trunks of trees that have a thick rind, which cannot be separated from the bark.

By another patent in 1816, the art of tanning by decoction is still further improved. This Patentee has proved that the trunk, roots, limbs, branches, and *leaves* of the oak, whether tree, pollard, coppice, or underwood, possess tanning properties in a sufficient quantity to be employed with advantage for tanning, by reducing them to chips or saw-dust, and then boiling and using them in the following way:—

To tan calf, or other thin skins, put one hundred weight of the limbs or branches, chopped as above mentioned, into a copper containing about sixty gallons of water, and boil, till the water be reduced to from thirty-five to forty gallons; draw off the decoction.

Now add to the same limbs or branches forty gallons of water, and again boil till the water be reduced to about twenty-five gallons. The liquor thus produced by the second boiling is used as a weak ooze, in the first process of immersing the calf-skins, after they come from the scouring beam. The decoction first produced, is then to be used in the same way.

To tan *hides*, take one hundred weight of the limbs or branches, three-quarters of hundred weight of oak saw-dust, (the sooner the latter is used after being made the better), and one-quarter of a hundred weight of the root, boil in eighty gallons of water, till reduced to from fifty to sixty gallons. Draw off the decoction, and put it aside for use. To the materials left in the copper add sixty gallons of water, and again boil, till reduced to from thirty to thirty-five gallons. The liquor produced by this second boiling is to be employed in the first stage of tanning hides after they come from the beam; and afterwards the decoction first produced is to be employed. The skins and hides having undergone the before-mentioned processes, add as much oak-bark or tan-liquor, or both, to the respective decoctions, as is necessary to complete the tanning. The quantity of each will vary according the strength of such decoctions; which strength will depend on the age and size of the tree, and other circumstances.

Of Sheep-skins.—Sheep-skins which are used for a variety of purposes, such as gloves, book-covers, &c., and which when dyed, are converted into mock-morocco leather; are dressed as follows:—They are first to be soaked in water and *handled*, to separate all impurities, which may be scraped off by a blunt knife on a beam. They are then to be hung up in a close warm room to putrefy. This putrefaction loosens the wool, and causes the exudation of an oily and slimy matter, all which are to be removed by the knife. The skins are now to be steeped in *milk of lime* to harden and thicken; here they remain for a month or six weeks, according to circumstances, and when taken out, they are to be smoothed on the fleshy side by a sharp knife. They are now to be steeped in a bath of bran and water, where they undergo a partial fermentation, and become thinner in their substance.

The skins, which are now called pelts, are to be immersed in a solution of alum and common salt in water; in the proportion of 120 skins to 3 pounds of alum and 5 pounds of salt. They are to be much agitated in this compound saline bath, in order to become firm and tough. From this bath they are to be removed to another, composed of bran and water, where they remain until quite pliant by a slight fermentation. To give their upper surfaces a gloss, they are to be trodden in a wooden tub, with a solution of yolks of eggs in water, previously well beaten up. When this solution has become transparent, it is a proof that the skins have absorbed the glazing matter. The pelt may now be said to be converted into leather, which is to be drained from moisture, hung upon hooks in a warm apartment to dry, and smoothed over with warm hand-irons.

To prepare sheep leather for various elegant purposes, by drying; the skins, after being taken from the lime-bath, are to be immersed in another, composed of dog and pigeon dung dissolved by agitation in water; here they remain until the lime is separated, and until the skins, have attained the state of *soft pliable pelt*. To dye this pelt *red* the skins are to be washed and sewed into bags, and stuffed with clippings and shavings of leather, or any other convenient substance, and immersed with the *grain side outwards* in a bath of alum and cochineal of the temperature of 170° or 180° Fahr., where they are to be agitated until they are sufficiently dyed. Each bag is, now to be transferred to a *sumach* bath, where they receive consistency and tenacity. From this bath it is customary to remove the skins, and to plunge them into a saffron one, to improve their color.

To dye these skins *black*, the washed pelt is first immersed in the sumach bath, and then to be rubbed over on the grained side, by a stiff brush dipped in a solution of acetate, or pyrolignite of iron.

To give these skins the grain and polish of morocco leather, they are first oiled and then rubbed on a firm board by a convex piece of solid glass, to which a handle is attached. The leather being now rendered more compact, is rubbed or pressed hard, by a sharply grooved box-wood instrument, shaped like the glass one just described.

Lamb and kid-skins are dressed, tanned, and dyed in a similar manner.

Morocco Leather.—Goat-skins are to be cleansed, have their hair removed, and to be limed as in the before mentioned processes. They are then to undergo a partial fermentation by a bath of bran and water, and afterwards to be immersed in another bath of *white figs and water*, where they are to remain for five or six days. It is now necessary to dip them in a solution of salt and water, to fit them for dyeing. To communicate a *red* color, the alum and cochineal bath is to be used for sheep-skins; for *black*, sumach, and iron liquor as before: and for *yellow*, the bath is to be composed of alum and the pomegranate bark.

The tanning, dressing, and graining are the same as for sheep-skins.

Russia Leather.—Calf-skins being steeped in a weak bath of carbonate of potass and water, are well cleaned and scraped, to have the hair, &c. removed. They are now immersed in another bath, containing dog and pigeon's dung in water.

Being thus freed from the alkali, they are thrown into a mixture of oatmeal and water, to undergo a slight fermentation. To tan these hides it is necessary to use birch bark instead of oak bark; and during the operation they are to be frequently handled or agitated. When tanned, and perfectly dry, they are made pliable by oil and much friction; they are then to be rubbed over gently with *birch tar*, which gives them that agreeable odour, peculiar to this kind of leather, and which secures them against the attacks of moths and worms. This odour the leather will preserve for many years; and on account of it, Russia leather is much used in binding handsome and costly books. The marks, or intersecting lines on this leather, are given to it by passing over its grained surface, a heavy iron cylinder, bound round by wires.

To dye this leather of a *black* colour, it is to be rubbed over, after tanning, with a solution of acetate, or pyrolignite of iron: to dye it *red*, alum and Brazil wood are used. At Astrakhan, in Tartary, another kind of leather, both beautiful and durable, is manufactured from deer and goat-skins. They are cleaned and dressed in the same manner as sheep-skins, and then put into a bath of bran in a state of fermentation with water, for three days. Each skin is then put into a wooden tray, where being spread out, it receives a portion of a liquor composed of honey and water. When the skin has combined with this liquid, it is immersed in very salt brine for a short time, and is then dried. To dye it *red*, it is to be made up in bags, and dipped in a bath of cochineal water, and an alkaline plant found in the deserts; it is now to be immersed in a solution of alum, and then tanned with sumach. To give this leather a brilliant and more *lasting red*, it is dipped in an infusion or decoction of galls, instead of sumach. When to be dyed *yellow*, the berries of buckthorn, or the flowers of wild camomile are used. The graining of this leather is given by an iron instrument of great weight, having a number of blunt points.

Tanning Nets.—The following method was invented by a ship-builder at Bridport. He puts one hundred weight of oak branches and one hundred weight of spent bark from any tannery, into one hundred gallons of water, and so in proportion, for a greater or less quantity. After boiling the same till reduced to about eighty gallons, he takes the branches and spent bark from the copper, by means of any convenient instrument, and then immerses as many nets, sails, or other articles, as are required, into the liquor left in the copper; taking care, that they are completely covered. He boils the whole together for about three hours, then removes the fire, and suffers the liquor to get cool: after which he removes the nets, sails, or other articles, from the furnace, and hangs them up to dry.

ANSWERS TO QUERIES.

105—*How is Hair sorted into Lengths and Cleansed?* In the manufacture of hair pencils or brushes, the hairs are scoured in a solution of alum, till they are free from grease, and then steeped 24 hours in luke-warm water. The water is next squeezed out by pressing them strongly from the root to the tip. They are then dried by pressure with linen cloths, and combed as smooth as possible. Bunches of hair are then placed in small flat-bottomed tin pans, with the tips of the hair upwards, on striking the bottom of the pan the hairs get deranged parallel to each other, and the long hairs standing higher than the others may easily be picked out.

115—*How are the colored Flames of Fire-works produced?* Answered in page 256 and in page 328.

119—*How are Essential Oils distilled?* The plant from which the oil is to be obtained, is introduced into a still, water is poured upon it, and heat being applied, the oil is volatized by the watery vapour, at the temperature of 212°, though alone it would probably not distill over unless the heat were 100° more. Some oils of a nature not very volatile require a higher degree than 212°, to raise them in vapour, and must be dislodged by adding common salt to the water, whereby the heat being augmented 15°, they readily come over. If in such distillations too much water be added, no oil will be obtained, because it is partially soluble in water, and thus readily an aromatic water is produced.

120—*Is there a Geometrical Rule for obtaining an Equilateral Triangle equal to a given Square, and in what Author?* In Euclid, Book 6, Prop. 25, you will find the following problem:—

To describe a rectilineal figure, which shall be *similar* to *one*, and equal to *another* given rectilineal figure—consequently if the last-named figure be a square, and the former one any equilateral triangle; an equilateral triangle can then be obtained equal to any given square.

123—*How is White Marble best Cleaned and Whitened?* Answered in page 232.

134—*How is the Ox-Gall Paste used by Draughtsmen, prepared?* Take the gall of newly-killed oxen, and having allowed it to settle 12 or 13 hours in a basin, pour the supernatant liquor off the sediment into an evaporating dish of stone ware, and expose it to a boiling heat in a water bath, till it is somewhat thick. Then spread it on a dish, and place it before a fire till it becomes nearly dry. In this state it may be kept for years in pots covered with paper.

136—*How are colored Crayons made?* They are made of the following composition:—

Six parts of shell-lac.

Four parts of spirits of wine.

Two parts of turpentine.

Twelve parts of a coloring powder, such as Prussian blue, orpiment, white-lead, vermillion, &c., and

Twelve parts of blue clay.

The clay being elutriated, passed through a hair sieve and dried, is to be well incorporated by trituration with the solution of shell-lac in the spirit of wine, the turpentine, and the pigment; and the doughy mass pressed into moulds. They are to be dried by a stove heat.

[Very good crayons, for certain purposes, may be made as follows:—

Wash common pipe-clay in a large quantity of water, let the coarser parts, sand, &c. settle for a few minutes, then pour off the clayey water and set it aside, the clay will subside and be fit for use. When the supernatant water is tolerably clear, pour it off and add to the clay at the bottom the required pigment, together with a little size. Press it into moulds as before. White crayons made thus are infinitely better than common chalk for the lecturer to draw his diagrams with, and for the workmen to set off his lines. The fancy painter too uses black crayons made after this manner, for the veins of white marble, and others of different colors might be still more frequently employed.—Ed.]

157—*Mineral Marmoratum; what is it?* Each dentist has his own receipt. The following we know to be impenetrably hard:—Calcine a flint stone in the fire; when white and friable, pound it in a mortar, sift it, and lay aside the finest particles for use; add to them equal parts, by weight, of quicklime and mastic varnish; pound the whole together, and sift as before. It may be kept in a phial till wanted for use, when a small portion is to be taken out, and water added, until it assumes a pasty consistence, when it may be pressed into the tooth. A totally different composition is also called *mineral marmoratum*, which is composed of tin-foil and quicksilver mixed together, so as to be just pliable, and squeezed into the tooth. The quicksilver will soon be absorbed, and the tin-foil remain as a sort of metallic plug.

158—*What is the Composition used by Dentists to take a Model of the Mouth?* Nothing but common white wax, rendered sufficiently soft by steeping it in warm water for some minutes previously to using it.

160—*What is Caouchoucine, and how is it prepared?* Caouchoucine is the invention of Mr. W. H. Barnard, of Greenwich, and is obtained by distilling caouchouc, (Indian rubber,) as imported. When the temperature has reached 600°, a dark colored oil or liquid is distilled over, which is caouchoucine. This substance, when mixed with alcohol, is a solvent of all the resins, particularly copal. It possesses some singular properties, viz. that in a liquid state it has less specific gravity than any other liquid known to chemists, being considerably lighter than sulphuric ether, and in a state of vapor, is heavier than the most ponderous of gases. Its elementary constituents are—carbon, 6.812, 8 proportions; hydrogen, 1.000, 7 proportions.

161—*Why do new Tobacco Pipes stick to the Mouth?* Because aluminum, of which they are composed, after having been burnt, like lime, rapidly absorbs moisture, and in its strong attraction for this, it adheres to any part which is but partially wet. Dipping the pipe in a liquid previous to using it prevents this adhesion.

162—*How is Glass to be drilled?* I beg to say I have drilled common glass with an ordinary bow-drill, by keeping one or two drops of spirits of torpentine on the glass at the point of the drill; of course care must be taken not to apply too much pressure, or you will break the glass. W. S. E.

[We have not much faith in the above receipt. Glass may be drilled readily with a common drill made of iron, tin, or copper, using with it water and emery powder. If a large hole is required, such, for example, as one of an inch in diameter, it may be done as follows:—Fasten on the appointed spot a cork which is a little smaller than the intended hole; procure a thin brass tube 3 or 4 inches long, of the size of the hole, and to the upper end of this fit a piece of wood, pointed at the top: put some emery powder around the cork, slip the tube over it, and keep turning the tube round by a drill bow, the tube being kept steady by the cork at bottom, and by its point working in a hole at the top, which may be made in a piece of wood, to be held by one hand while the tube is worked round by the other. Ed.]

165—*How can White Ink be made?* Grind egg-shells, (carefully washed and the internal skin removed) to a fine powder, and put them into a small vessel of clean water. When settled pour the water off, and dry the powder in the sun; next put a small quantity of gum ammoniac into distilled vinegar, and leave it to dissolve during the night, next morning the solution will appear very white, and if strained through a linen cloth, and the egg-shells added in sufficient quantity, a very white ink will be obtained.

N.B. Black, or dark blue paper must be the material to be written upon.

PRINTING FROM COPPER-PLATES, WITH ALTERED DIMENSIONS.

Some very singular specimens of an art of copying, not yet made public, were brought from Paris a few years since. A watchmaker in that city, of the name of Gonord, had contrived a method by which he could take from the same copper-plate, impressions of different sizes; either larger or smaller than the original plan. Having procured four impressions of a parrot, surrounded by a circle, executed in this manner, I showed them to the late Mr. Lowry, an artist equally distinguished by his skill, and for the many mechanical contrivances with which he enriched his art. The relative dimensions of the several impressions were 5·5, 6·3, 8·4, 15·0, so that the largest was nearly three times the linear size of the smallest; and Mr. Lowry assured me that he was unable to detect any lines in one which had not corresponding lines in the other. There appeared to be a difference in the quantity of ink, but none in the traces of the engraving, and from the general appearance it was conjectured that the largest but one was the original impression of the copper-plate. The processes by which this singular operation was executed have not been published; but a conjecture was formed at the time which merits notice. It was supposed that the artist was in possession of some method of transferring the ink from the lines of a copper-plate to the surface of some fluid, and of re-transferring the impression from the fluid to the paper. If this could be accomplished, the print would be of exactly the same size as the copper-plate from which it was derived; but if the fluid were contained in a vessel of the form of an inverted cone, with a small aperture at the bottom, the liquid might be lowered or raised in the vessel, by gradual abstraction or addition, through the apex of the cone: in this case, the surface to which the printing-ink adhered, would diminish or enlarge. And in this altered state the impression might be re-transferred to paper. It must be admitted that this conjectural explanation is liable to very considerable difficulties; for although the converse operation of taking an impression from a liquid surface, has a parallel in the art of marbling paper, the possibility of transferring the ink from the copper to the fluid requires to be proved.

QUERIES.

166—How can old oil paintings be lined with new canvass? *Answered on page* 411.

167—How are the turkey's-maw balloons made?

168—How are Bath bricks made?

169—How is gilding on glass performed, such as is seen frequently in chemist's shops? *Answered on page* 414.

170—Why do candles become white by storing, and also have their illuminating power increased thereby? *Answered on page* 414.

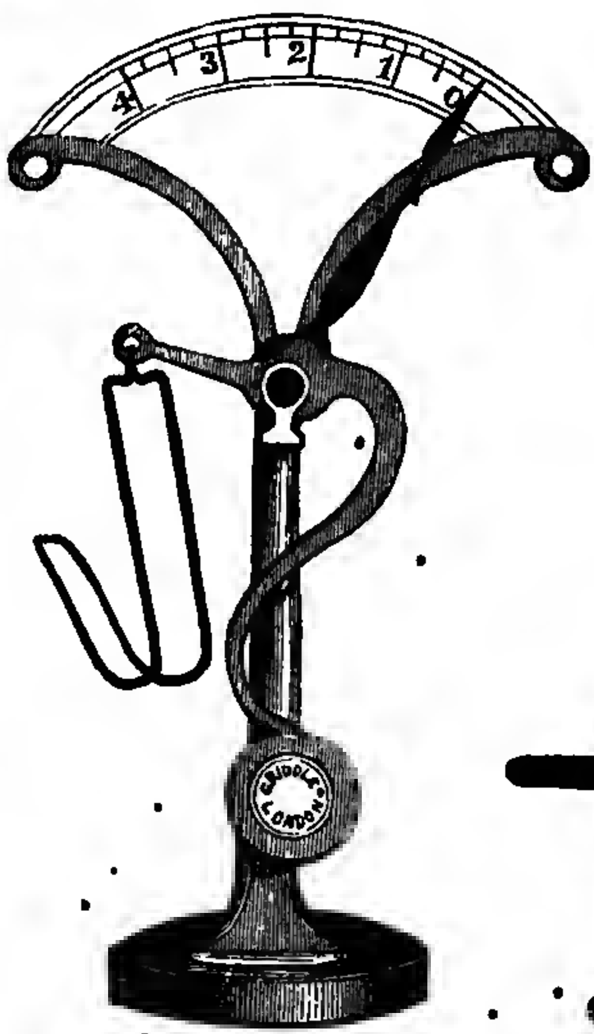
171—How are artificial eyes made?

172—What will soften old and hard putty? *Answered on page* 414.

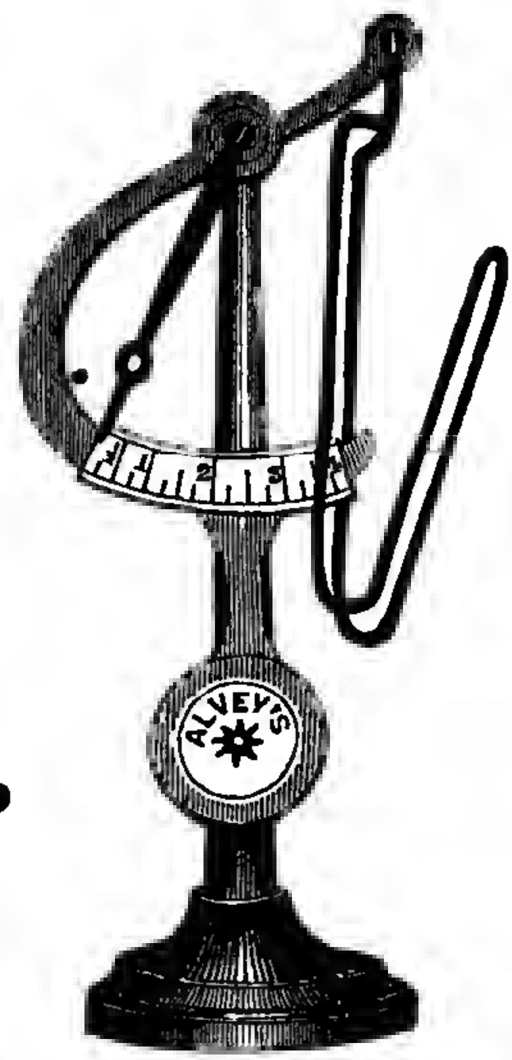
173—How is wood prepared for the wood engraver? *Answered on page* 414

174—How can a blue color, which will not wear off, be given to steel?

Fig. 1.



2.



3.

LETTER WEIGHING MACHINES.

LETTER WEIGHING MACHINES.

Since the announcement that letters were to be charged according to their respective weights, ingenuity has been exercised in order to construct the most portable, accurate, and convenient letter weigher; and we understand that very numerous designs for such an instrument have been registered under the new Copyright Design's Act, whereby any person may claim the sole use of any pattern for six months, whether it be adapted to embroidery, weaving, general ornament, articles of manufacture and art, &c. &c. Thus the stationers of the metropolis have each some certain arrangement or figure of letter weigher, which they are desirous the public should patronize. To point out such as are defective and cumbrous would be invidious, and as we are not called upon to do so, would be unnecessary. The object of the present paper is rather to point out three or four which are types of all, and which appear the simplest and most easily managed.

The first we shall allude to is the invention of Mr. Riddle, and one of the first that was brought out. It is represented in Fig. 1. The principle of its action is that of the bent lever. This lever is supported upon a pivot at the centre, one part of it is curved round and downwards, and loaded with a fixed weight; the other end of the lever bears a suspended wire, so bent as to be capable of holding a letter; to the centre of the lever is fixed a gnomon, or hand. It is supported by a short iron bronzed stand, which branches near the top and bears an arc divided into four equal divisions or ounces, and which are subdivided into half and quarter ounces. The letter being put in the wire, draws up the other end of the lever, and moves the hand forwards to half, one, two, or more ounces, according as the letter itself may weigh so much; when taken out the lever of course returns to its original position.

In Mr. Alvey's letter weigher, the same principle, that of the *bent lever balance*, is relied upon; but here, instead of the arc being attached to the stem, and the hand, or pointer, being connected and moving with the lever, the reverse takes place, the hand is fixed and immoveable; the lever itself bears the arc, and when the latter is placed in the part prepared for it, its weight draws the graduated part of the lever underneath the point of the hand, and thus the exact weight of the letter is at once seen, as in the former instance. *(See Fig. 2.)*

The *common scale*, or equal-armed balance, has not been forgotten to be applied by numerous persons, but without any originality; and it must be evident, that in a counting-house, and much more so in a study, such a cumbrous appendage as the usual scales is inconvenient, and the separate detached weights liable to be lost

The *steelyard* is another adaptation of the same mechanical power to the same object; and steelyard balances, graduated to the requisite ounces and parts, are abundant; some of them suspended from above, with a fixed fulcrum, and a moveable weight; others with a fixed weight and a divided stem, which slides forwards or backwards over a knife-edged support. In the first case the weight of the letter is indicated by the part of the stem occupied by the weight; in the other instance by the part of the stem, which forms the point of suspension.

Another class of letter-weighing machine is formed upon the known *specific gravity of mercury;* one of this kind is represented in Fig. 3. The name of the inventor we are not acquainted with. It consists of a stand at bottom, into which is fixed a glass tube, having a wooden ball or ornament of some kind at top. with a hole in the middle of it, equal to that of the tube to which it is cemented. A rod of wood, bearing a small stand or table at top, is made to fit the hole of the stem, into which it is suffered to drop—but not before a little quicksilver has been poured into the tube; the specific gravity of this being so much greater than the wooden rod, the latter of course floats, or rather sinks but a little way into the mercury, and according as the table attached to it is loaded, so the rod sinks deeper and deeper. This superior weight is indicated by the proper marks being made upon the centre rod, the surface of the mercury rising as the rod is depressed beneath. In the foregoing structure it is of little consequence if the mercury be in large or small quantities, provided there is a sufficiency of it for the rod to sink into. Another mercurial letter weigher has been made with lines upon the glass outside, and not upon the moveable rod; this therefore requires a very exact quantity of mercury at all times, and the spilling of a few drops only would vitiate the result. We are somewhat surprised that both the flat, spiral, and the heliacal or birdcage spring, appear to have been forgotten, not remembering to have seen any contrivance for weighing letters, having the elasticity of bodies for its *primum mobile.*

TURNING LARGE BALLS, &c.

Prepare a cube of wood, as accurately as may be; plane one side true, and guage a line down the middle of it; from which line the centres at each end are found with a pair of compasses. Then shape the piece to an octagonal form, by taking off the four corners; next, place it in the lathe, then turn or strike each end to the exact length of the intended diameter of the sphere. Afterwards, with a pair of compasses, divide the piece which gives the centre or curve-line, and bisects the guage-stroke. Next. from the middle of the piece, work down each end of it with a gouge, to as fair a round as you can with the callipers: then take the piece out of the lathe, and carefully prick the second centres, which the guage-stroke and curve-line give: place the piece again in the lathe, by the last pricked centres, working it down with a small firmer chisel, in order to form a second curve-line, until it bisects the first diameter, or curve-line: then strike the piece to the first centres, and work off the remaining wood with a large firmer chisel, until it becomes flush with the second curve-line: it may then be polished.

Billiard Balls.—The ivory balls for billiard playing are carefully finished by hand, after the lathe has done its work, by means of flat steel plates, hardened and tempered, having holes in them of various sizes, and made truly circular; the edges of the holes also being very sharp. In these holes the balls are worked in every direction, and scraped until all the protuberances are completely removed, and they become perfect spheres, after which they must be polished.

Wash Balls.—Whilst we are treating on the subject of forming globular bodies, it may not be amiss to mention that the perfumers shape their lumps of marbled and other soap into balls by means of a conical glass, the brim of which has been ground accurately true and sharp upon a flat surface. The mass of soap being held in the left hand, the brim

of the glass is worked over its surface in all directions, with the right band, at the same time that the ball is turned every way by the left; the excess of soap is thus removed; and in this easy mode are these regularly-formed hodies made, the glass performing a nearly similar office with the circular holes in the steel plates, as applied to tha finisbing of the ivory balls.

SUGARS.

(Resumed from page 334, and concluded.)

Sugar of Manna (Mannite.)—Manna exndes from the trunks of the *Fraxina* and of the *Pinus Larix*, in the form of a syrupy liquid, whicb hardens in the air into slightly yellowish drops. This liquid contains a small quantity of cane sugar, a *yellowish matter* to wbich it owes its laxativa qualities, and a considerable preportion (66 per eent.) of sugar of manna. This is extracted by boiling alcohol, which deposita it on cooling. It is tben exposed to pressure, re-dissolved, and crystallized. In order to extract it from the juice of onions, beet, celery, or asparagus, which contain it associated with cane sugar, we must decompose the latter by the vinous fermentation. Tha sugar of manna remains, and may be obtained in the crystalline form. This variety of sugar gives a brick-red color with srsenic acid. It dissolves the oxide of lead, which may be afterwards precipitated by ammonia. It has not been found to retain in any appreciahle degree the laxative properties of the manna.

Glycerine (Chevreul), or *Sweet Principle of Oil* (Scheele).—This suhstance is syrupy, transpareut, colorless, and slightly sweet. Its specific gravity is 1.270 at 62 degrees. It is very soluble hoth in water and alcohol. By distillation *it is vaporized* and partly decomposed. It attracts the moisture of the air. When throwa on hot coals it burns *like an oil*. It is capable of dissolving tbe oxide of lead. Nitric acid converts it, but with difficulty, into oxalic acid; and sulphuric acid changes it into sugar of starch.

It is ohtained by heating a mixture of two parts of pounded litbarge, two of olive oil, and about one of water, in a copper hasin. The mixture must he stirred with a spatula, and water must be added to supply the waste hy evaporation. The operation is stopped when the mixture bas acquired tbe consistence of plaster. The water, wbicb bolds the glycerine dissolved, is then to be poured off, and hydro-sulphuric acid must be passed througb it to throw down tbe small quantity of lead which it might contain. The excess of this acid must he driven off by heat, after which it is to be concentrated *in vacuo*, or by a gentle heat. This principla may also be produced hy the action of all the hases that are capabla of causing the saponification of fatty matters.

Sugar af Milk.—This substance is said to crystallize in regular parallelnpipeds, terminated by four-sided pyramids. These crystals are white and semi-transparent. They crackle under tba teetb, and decrepitate and swell on hot coals. They are soluble in nine times their weight of cold water, but more solnble in bot water. They are scarcely soluble in alcohol. This sugar becomes more soluble in water, looses its property of crystallizing, and assumes all the *characters of gum*, when it is exposed to heat. Potasb and soda also increase its solubility. The action nf nitric and snlpburic acids on it are exactly the same as on gum arabic. It is not precipitated from its solntion in water by any salt or by any of tbe alkalis, nor does the infusion of galls render it turbid. Potash causes a disengagement of ammonia from it, unless it has been previously crystallized a considerable number nf times successively. It is obtained from whey by evaporation. It is in Switzerland that most of it is prepared.

Sugar, or rather *Juice of Liquarice*. This substance is extracted from the roots of the *Glycyrrhiza Glubra* and tbe *Abrus Precatorias*, by means of boiling water. The liqnid is afterwarda evaporated by a gentle heat, and sulphuric acid is added, which precipitates botb the sugar of liquorice and the vegetable albumen. The precipitate is first washed with water acidulated with sulphuric acid, and then with pure water: and then the sugar is dissolved out hy alcohol, wbich does not act nn the albumen. A solution of carbonata of potash is added drop by drop to the liquid, as long as it gives any indication of containing frea acid, after which it is filtered and evaporated. The sugar is thns obtained in the form of a yellow translucent mass, full of cracks or flaws, which is easily detached from the sides of the vessel. The sugar obtained from concrete liquorice juice, or Spanisb liquorice, is of a brown color, which is not altered by treating it with animal charcoal. The sugar of liquorice has a taste somewhat different from that of liquorice juice, whicb is always slightly nauseous. It is equally soluble in water and in alcobol. When thrown in the state of powder into a flame, it hurnt like the pollen of *Licopodium*. Acids, both organio and inorganic, as well as the bases and certain salts, precipitate the sugar extracted from tbe *Glycyrrhiza Glabra*, but not that obtained frem the *Abrus Precatorias*.

Uses of Sugar.—Cane sugar appears to have been unknown in Europe prior to tbe period of tha wars of Alexander the Great; and subseqnent to that time it was only employed in medicine by tbe ancients, on account of its scarcity. For all domestic and other purposes honey aloue was used. It was not till tbe period of the crusades that the Venetians made it more generally known in Eurepe, and its use becama common only after the discovery of America and the establishment of plantations in the colonies.

Sugar is employed for making syrups; and in this state it serves to sweeten, thicken, and preserve tbe vegetable juices whicb are made use of in medicine. Fruits, or portions nf fruits, are also boiled in syrup, and preserved by means of it, forming what are called preserves. It has been likewise found that sugar is an excellent antiseptic, and that a much smaller quantity of it than nf sea-salt is sufficient to prevent putrefaction; and fisb are sometimes preserved by filling them with sugar in powder after thay are cleaned.

Orfilla recommended sngar as an antidote to the poison of verdigrise and oxide of copper. The efficacy of this means bas been qnestioned, and albumen is now used in preference.

AEROSTATION.

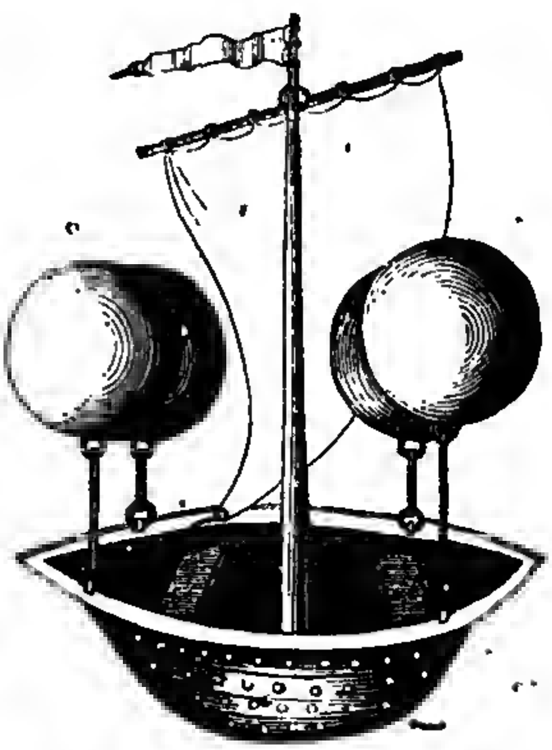
The desire of rivalling tbe feathered tribes in their passage througb tbe airy regions has now, for many years, called into action the imitative faculties of man. The art of flying bas been always his aim, and notwithstanding the conclusive arguments whicb bave been brought forward to prove its impracticability, yet there are still some visionary minds who maintain the prebability of its being at some time accomplished.

To prove the antiquity of this pursuit we need only consult the poetical productions, tha traditions, the religious tenets, or even the history of all nations. The flying horses of the sun, Juno's peacocks, Medea's dragons, the flying oracles, the flight of Abaris round the earth, as related by Diodorus of Sicily, the oracle of Hierapolis, who raised himself in the air, the fate of Icarus, and numberless other passages of the ancient writers, show that at a very early period the object of flying engaged the genius and attention of mankind. But the earliest account of any thing relating to the art of flying, which has the appearance of authenticity, is that of Archytas's pigeon. This famous geometrician of Taranto flourished about 300 years before the Christian era. Aulus Gellius, Favorinus the philosopher, and many other Grecian writers, speak of this pigeon. They describe it as made of wood, and that it could fly, but that if it fell it could not lift itself from the ground.

Much has been said and done, especially in the last century, in order to imitate this flying artificial bird, as may be gathered from the writings of Father Laurette Laure, Scholt, Cardan, Scaliger, Fabri, and Lana, though the reader's curiosity will be ill-requited for his trouble, those attempts being mostly errors of too gross a nature even for the last and preceding century.

In Rome, under the reign of Nero, it is said, that a man by means of artificial wings, elevated himself high in the atmosphere, but that he lost his life in the enterprize. In severals authors we find an account of singing and flying artificial birds; but while oppression and ignorance kept Europe in slavery and superstition, it is no wonder that accounts generally absurd, and always doubtful, of flying machines, flying vessels, flying saints, and flying witches, were very common, and the religious historians, as well as other writers, make frequent mention of them.

But to proceed to modern times. The most remarkable treatise on this subject that ever was written was by Bishop Wilkins, who died in 1671, and was the original proposer and founder of the Royal Society of London. He says there are four ways of flying. First, by the aid of spirits or angels. Secondly, by the help of fowls. Thirdly, by wings fastened immediately to the body; and fourthly, by a flying chariot. It is not necessary to advert to the first of these methods: as for the second, the high degree of improbability will readily occur to any thinking person. The third is equally impracticable as will be evident if we will make a short calculation on the expansa of the wings of birds, compared with the weight of their bodies; thus a sparrow or other small bird weighs about an ounce and a half, while the surface of its wings are about twenty square inches. Taking the average weight of a man to be one cwt. and a half, in the sama proportion his winga must be each twenty feet long, and seven or eight feet wide, not taking into consideration their weight, and that of the tail or rudder, which he must also be furnished with—a weight much too great for him even to move by the strength of his arms, much less to use them effectually. Then again how great a power the wind would exert to baffle his motions, as the least breeze would render them quite unmanageable. These visionary schemes of Bishop Wilkins gave rise to the well-known popular story of Pater Wilkins and the Gowries, or the Flying Islanders. The fourth method of flying is not so wholly to be disregarded: namely, by means of flying machines, though truly laughable are some of the schemes proposed for this purpose. Thus we find it directed to fill a great many egg shells with dew, for as the sun rarefies, and consequently elevatas the dew, so the egg shells when exposed to that luminary will rise, together with a certain weight attached to them, in consequence of the dew which they contained being rarefied. Among these projectors, one device alone deserves our attention, that of Jesuit Francis Lana, an Italian philosopher and professor. This may truly be said to be the first aerostatic machine, and although it would not ascend, it seems to have furnished a model for after projectors to imitate. It is represented as follows:—



The lower part of the machine is a large boat-shaped wicker basket, with two seats within it for the aeronaut, and a mast and sail to direct and occasion its lateral motion, while its power of ascension was to be derived from four very light copper balls, having a valve to each through which the air within might be abstracted. Lana knowing that a pint of air weighs six grains, calculated the size of his balls, so that the weight of the air within them should more than counterpoise the weight of the machine and of himself. So certain of success was Lana that he collected a great assembly of his pupils and of the public to witness his ascent. It need not be said that the first few strokes of the exhausting pump crushed his copper balls, and his expectations at the same time.

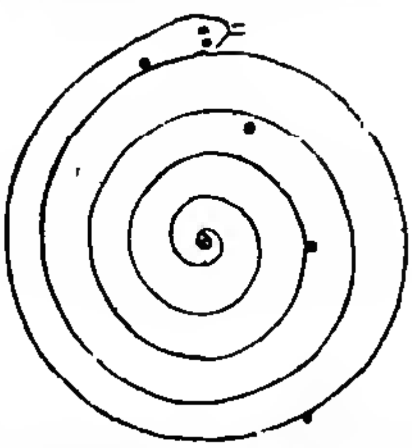
Although all these schemes were unsuccessful, yet the art of navigating the air has been at last discovered, and upon two principles. First, on the rarefaction of common air by heat; and secondly, by filling the machine with a gas lighter than the atmospheric air.

The first of these principles particularly struck the attention of Stephen and John Montgolfier, from the following experiment:—Suspend upon a point or edge a strip of wood, bearing a disc of thin pasteboard or paper at one end, and a counterpoise or weight at the other. When thus balanced, hold at a few inches distance under the paper disc a lighted candle. The air around the flame being heated, and consequently rarefied,

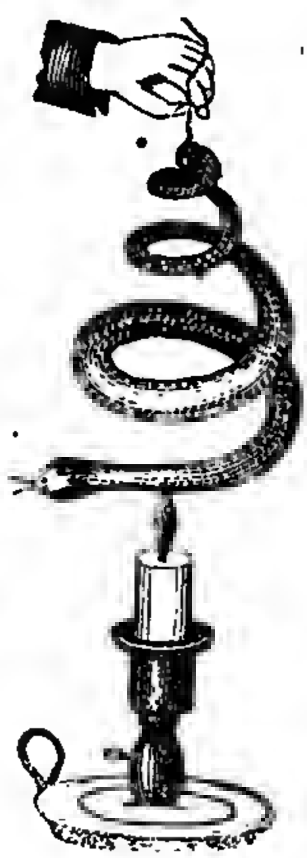
ascends, carries up with it the paper, and destroys the equality of the balance. The candle being removed, it returns to its former station.

The same principle as the above carries up the chimney a light piece of paper from the fire, as too many persons have learnt by sad experience and dangerous accidents.

Many modifications of this experiment will readily suggest themselves. One of them is extremely common in times of illumination, in which we witness a coiled strip of paper turning round over a candle placed in a window. It is represented as follows, and is usually called the *fire snake*. A piece of thick writing paper is chosen, about six or eight inches over; it is to be cut in a continued coil till it reaches near to the centre, where a thread drawn through serves to hang it up by. (It may of course be painted according to fancy.)



When in use, it is to be merely suspended over a candle, the air heated by which ascending strikes the lower part of the coil, and slides upwards, and so does every portion of heated air which reaches any part of it—thus the impulse is given, and the snake is always turning round.



Stephen, the eldest of the two brothers, made the first aerostatic experiment at Avignon, towards the middle of November, 1782. It consisted of a bag of fine silk, the capacity of which was about forty cubic feet. Burning paper applied to the aperture served to rarefy the air, or to form the cloud, and when this was sufficiently expanded, the machine ascended rapidly to the ceiling, and thus the discovery was made. It may be readily supposed that this interesting experiment was soon afterwards repeated, and upon a larger scale. On the 19th September, 1783, a public exhibition was made before the King and Court of France, at Versailles, with a balloon, sixty feet high and forty-three feet in diameter. It ascended with rapidity with a basket attached to it by a rope, in which basket were placed a sheep, a cock, and a duck. After about eight minutes, the fire being out, the machine descended, without any of the animals being injured, so that the sheep was found feeding.

M. Pilatre de Rozier had the courage to offer to ascend in one of these machines. His offer was accepted, and he ascended in a balloon, seventy-six feet in length and forty-six feet in breadth, on the 15th of October, 1783.

(To be continued.)

GILDING.

Gold Powder for Gilding.—Gold powder may be prepared in three different ways:—1st. Put into an earthen mortar some gold-leaf, with a little honey, or thick gum-water, and grind the mixture till the gold-leaf is reduced to extremely minute particles. When this is done a little warm water will wash out the honey or gum, leaving the gold behind in a pulverulent state.

2nd.—Dissolve the pure gold (or the leaf,) in nitro-muriatic acid, and then precipitate it by a piece of copper, or by a solution of sulphate of iron. The precipitate (if by copper,) must be digested in distilled vinegar, and then washed, (by pouring water over it repeatedly,) and dried. This precipitate will be in the form of very fine powder: it works better, and is more easily burnished than gold-leaf ground with honey as above.

And 3rd, or the best method of preparing gold powder, is by heating a prepared amalgam of gold, in an open clean crucible, and continuing the strong heat, until the whole of the mercury is evaporated; at the same time constantly stirring the amalgam with a glass rod. When the mercury has completely left the gold, the remaining powder is to be ground in a Wedgewood's mortar, with a little water, and afterwards dried. It is then fit for use.

Although the last mode of operating has been here given, the operator cannot be too much reminded of the danger attending the sublimation of mercury. In the small way here described, it is impossible to operate without danger; it is therefore better to prepare it according to the former directions, than to risk the health by the latter.

To cover Bars of Copper, &c. with Gold, so as to be rolled out into Sheets.—This method of gilding was invented by Mr. Turner, of Birmingham. Mr. Turner first prepares ingots or pieces of copper or brass, in convenient lengths and sizes. He then cleans them from impurity, and makes their surfaces level, and prepares plates of pure gold, or gold mixed with a portion of alloy, of the same size as the ingots of metal, and of suitable thickness. Having placed a piece of gold upon an ingot intended to be plated, he hammers and compresses them both together, so that they may have their surfaces as nearly equal to each other as possible; and then binds them together with wire, in order to keep them in the same position during the process required

to attach them. Afterwards he takes silver filings, which he mixes with borax, to assist the fusion of the silver. This mixture he lays upon the edge of the plate, and next to the ingot of metal. Having thus prepared the two bodies, he places them on a fire in a stove or furnace, where they remain until the silver and borax placed along the edges of the metals melt, and until the adhesion of the gold with the metal is perfect. He then takes the ingot carefully out of the stove. By this process the ingot is plated with gold, and prepared ready for rolling into sheets.

To Gild in Colors.—The principal colors of gold for gilding are red, green, and yellow. These should be kept in different amalgams. The part which is to remain of the first color, is to be stopped off with a composition of chalk and glue: the variety required is produced by gilding the unstopped parts with the proper amalgam, according to the usual mode of gilding.

Sometimes the amalgam is applied to the surface to be gilt, without any quicking, by spreading it with aqua-fortis; but this depends on the same principal as a previous quicking.

Grecian Gilding.—Equal parts of sal-ammoniac and corrosive sublimate are dissolved in spirit of nitre, and a solution of gold made with this menstruum. The silver is brushed over with it, which is turned black, but on exposure to a red heat it assumes the color of gold.

To dissolve Gold in Aqua-Regia.—Take an aqua-regia, composed of two parts of nitrous acid, and one of marine acid; or of one part of sal-ammoniac, and four parts of aqua-fortis; let the gold be granulated, put into a sufficient quantity of this menstruum, and exposed to a moderate degree of heat. During the solution, an effervescence takes place, and it acquires a beautiful yellow color, which becomes more and more intense, till it has a golden or even orange color. When the menstruum is saturated, it is very clear and transparent.

To Gild Iron or Steel with a solution of Gold.—Make a solution of 8 ounces of nitre and common salt, with 5 ounces of crude alum in a sufficient quantity of water; dissolve an ounce of gold thinly plated and cut, and afterwards evaporate to dryness. Digest the residuum in rectified spirits of wine or ether, which will perfectly abstract the gold. The iron is brushed over with this solution and becomes immediately gilt.

To Gild, by Gold dissolved in Aqua-Regia.—Fine linen rags are soaked in a saturated solution of gold in aqua-regia, gently dried, and afterwards burnt to tinder. The substance to be gilt must be well polished; a piece of cork is first dipped into a solution of common salt in water, and afterwards into the tinder, which is well rubbed on the surface of the metal to be gilt, and the gold appears in all its metallic lustre.

Amalgam of Gold in the large way.—A quantity of quicksilver is put into a crucible or iron ladle, which is lined with clay, and exposed to heat till it begins to smoke. The gold to be mixed should be previously granulated, and heated red hot, when it should be added to the quicksilver, and stirred about with an iron rod till it is perfectly dissolved. If there should be any superfluous mercury, it may be separated by passing it through clean soft leather; and the remaining amalgam will have the consistence of butter, and contain about 3 parts of mercury to 1 of gold.

To Gild by Amalgamation.—The metal to be gilt is previously well cleaned on its surface, by boiling in a weak pickle, which is a very dilute nitrous acid. A quantity of aqua-fortis is poured into an earthern vessel, and quicksilver put therein: when a sufficient quantity of mercury is dissolved, the articles to be gilt are put into the solution, and stirred about with a brush till they become white. This is called quicking. But, as during quicking by this mode, a noxious vapour continually arises, which proves very injurious to the health of the workmen, they have adopted another method, by which they, in a great measure, avoid that danger. They now dissolve the quicksilver in a bottle containing aqua-fortis, and leave it in the open air during the solution, so that the noxious vapour escapes into the air. Then a little of this solution is poured into a basin, and with a brush dipped therein, they stroke over the surface of the metal to be gilt, which immediately becomes quicked. The amalgam is now applied by one of the following methods:—

1st. By proportioning it to the quantity of articles to be gilt, and putting them into a vessel together, working them about with a soft brush, till the amalgam is uniformly spread.

Or, 2ndly. By applying a portion of the amalgam upon one part, and spreading it on the surface, if flat, by working it about with a harder brush.

The work thus managed is put into a pan, and exposed to a gentle degree of heat; when it becomes hot, it is frequently put into a pan, and worked about with a painter's large brush, to prevent an irregular dissipation of the mercury, till, at last, the quicksilver is entirely dissipated by the repetition of heat, and the gold is attached to the surface of the metal. This gilt surface is well cleaned by a wire brush, and then artists heighten the color of the gold by the application of various compositions; this part of the process is called COLORING.

To Gild Glass and Porcelain. No. 1.—Drinking and other glasses are sometimes gilt on their edges. This is done either by an adhesive varnish* or by

The varnish is prepared by dissolving in linseed oil an equal weight either of copal or amber. This is to be diluted by a proper quantity of oil of turpentine, so as to be applied as thin as possible to the parts of the glass intended to be gilt. When this is done, which will be in about twenty-four hours, the glass is to be placed in a stove, till it is so warm as almost to burn the fingers when handled. At this temperature the varnish will become adhesive, and a piece of leaf gold, applied in the usual way, will immediately stick. Sweep off the superfluous portions of the leaf, and when quite cold, it may be burnished, taking care to interpose a piece of very thin paper (India paper) between the gold and the burnisher. If the varnish is very good this is the best method of gilding glass, as the gold is thus fixed on more evenly than in any other way.

No. 2.—It often happens, when the varnish is but indifferent, that by repeated washing the gold wears off; on this account the practice of burning it in is sometimes had recourse to.

For this purpose, some gold powder is ground with borax, and in this state applied to the clean surface of the glass, by a camel's hair pencil; when quite dry, the glass is put into a stove heated to about the temperature of an annealing oven; the gum burns off, and the borax, by vitrifying, cements the gold with great firmness to the glass; after which it may be burnished. The gilding upon porcelain is in like manner fixed by heat and the use of borax;

and this kind of ware being neither transparent nor liable to soften, and thus to be injured in its form in a low red heat, is free from the risk and injury which the finer and more fusible kinds of glass are apt to sustain from such treatment. Porcelain and other wares may be platinised, silvered, tinned, and broozed in similar manner.

(Continued on page 380.)

RICE PAPER.

Rice Paper is prepared from a plant growing in China, and also in the East Indies. If this paper be held up to the light an exquisitely beautiful cellular tissue is observed, such as no art of man could produce or imitate. Its mode of preparation is a subject of much interest, as is the stem of the plant from which it is cut. The latter is evidently herbaceous, hollow in the centre, with a membraneous transverse septum at each end, about an inch in diameter, and the thickness of the parenchymatous substance is little more than half an inch, but of the purest possible white.

General Hardwicke, a gentleman whose long residence in India, and whose ardent love of natural history gave him opportunities of studying botanical science above what others have enjoyed, drew out the following account, which was inserted in a journal, called the *Quarterly Botanical Miscellany*.

"I am very glad that it is in my power to give information respecting the substance known under the name of *rice paper*. It has often interested me, and gratified my curiosity, to remark to how many [illegible]ul purposes it is applied by the natives of India. It grows abundantly on the marshy plains of Bengal, and on the borders of jeels, or extensive lakes, and every province between C[illegible] and Hurdwar. The plant is perennial, of straggling, low growth, and seldom exceeds a diameter of two inches and a half in the stem. It is brought to the Calcutta bazaars in great quantities in a green state; thickest stems are cut into laminæ, from which [illegible] natives form artificial flowers, and various ornaments, to decorate their shrines at Hindoo festivals. The Indians make hats of rice paper, by cementing together as many leaves as will make up to the proper thickness; in this way any kind of shape may be formed, and, when covered with silk or cloth, the hats are strong and amazingly light. It is an article of great use to fishermen, it forms floats of the best description to their extensive nets. The slender stems of the plant are bundled into fascines of about three feet long, and with one of these under his arm, the fisherman goes out daily to his occupation. With his net on his shoulder, he proceeds to work without a boat, and stretches it in the deepest and most extensive lakes, supported with this buoyant faggot.

"It is to be observed that the cutting of this material into leaves, or laminæ, is not performed by transverse sections of the stem, but made vertically round the stem. The most perfect stems are selected for this purpose; few are found sufficiently free from knots to produce a cutting of more than nine or ten inches in length.

"We may consider the whole stem of the plant as *pith*, for the bark is so thin and tender that it may be scratched off with the thumb nail. The laminæ run in different lengths. In Bengal the plant is called *shold*, commonly pronounced *sold*. The plant is an annual; the foliage and other parts of the plant, where water is wanting, die down to the roots; but where water is plentiful the stems remain and branch out afresh in the proper season."*

W. S. K.

ANIMALCULES, OR MICROSCOPIC AND INFUSORIAL ANIMALS.

(Resumed from page 340, and concluded.)

It would be exceedingly difficult, if not impossible, to convey to the mind, by any other representation than drawings, a correct idea of the varied forms of these singular beings, for in many instances they appear to have no similarity whatever with any other class of objects in nature. Some animalcules resemble spheres, others are egg-shaped; others again represent fruits of various kinds; eels, serpents, and many of the invertebrated animals; funnels, tops, cylinders, pitchers, wheels, &c. &c.; all of which are found to possess their own particular habits, and to pursue a course of life best adapted to their peculiar constructions. For instance, while some move through the water with the greatest imaginable rapidity, darting, leaping, or swimming, others merely creep or glide along; and many are altogether so passive, that it requires long and patient observation to discover any of their movements at all. Some descriptions are perceptibly soft, and yield easily to the touch; others are covered with a delicate shell or horn-like coat. Of the latter order there are different degrees of density, as in the Volvox, Gonium, &c., where the envelope is comparatively thick; and where, strange to say, the internal substance separates by the mode of propagation into several portions, forming so many distinct young ones, which at their birth burst the envelope, and the parent becomes entirely dissipated. In others of this order the shell is merely a plate covering the body, resembling that of the tortoise; sometimes it includes the body, so as to leave only two small apertures at the extremities, and at [illegible]ers it is bivalve, and incloses the [illegible] like [illegible] of the oyster or muscle.

[illegible]ertebrated animals are ei[illegible] or [illegible]ich terms sufficien[illegible] their [illegible]

I. Animalcules propagate by a [illegible] scissure, or division of their bodies into two or more portions, each one forming a new creature, which, on its arrival at maturity, pursues the same course. These divisions take place in some genera symmetrically, as in the Gonis, &c.; in others, by transverse, longitudinal, or diagonal sections. In these latter cases the produce have forms differently proportioned from those of the creatures from which they spring. 2. They propagate in the manner before mentioned of the Volvox, and some other genera, by a distribution of the internal substance of the parent into a proportionate number of young ones, all of which at their birth issue forth, and leave behind them nothing but the envelope, soon to be dissolved. 3. They are produced from germs, shooting forth from the parent's sides, &c. 4. From spawn, which in the act of being shed, carries along with it a portion of the parent animalcule.

With respect to the mode of viewing animalcules under the microscope, Mr. Pritchard directs, that they be placed in what are termed aquatic live-boxes, or on a slip of glass, in which case they should be covered with a thin plate of mica, which will have the effect of preventing the small quantity of water put with them from evaporating, and of

rendering the surface perfectly plane for the purpose of observation.

Having selected and placed the object for examination on the stage of your microscope, the next consideration will be how to regulate the illumination, and to select a suitable magnifying power. These points must be carefully attended to, for on them, even with the best instruments, much of the beauty and effect will depend. The most intense and best description of light is to be derived from either a sperm or wax candle, or from what is perhaps on the whole most convenient, the common Argand lamp. Concentrate this light on the object with a proper condensing lens, taking care at the same time, to reduce the quantity, if necessary, by means of diaphragms or stops placed under the stage: these should be rendered capable of adjustment as to distance from the object, &c., so as to transmit only a cone of rays of the proper dimensions.

A magnifying power of about 100 to 500 will be found to be sufficient for most purposes; although in an inspection of the monads, and some minute portions of other objects, a stronger one will doubtless be required. Little or no advantage will be gained from powers exceeding 800, as it is of far more importance to obtain a deep penetration and perfect definition than an excess of amplification. Apply in the outset, therefore, a low power, say 100, and if on trial it prove insufficient, double it, and proceed onwards, until you are satisfied as to the result, taking it as a general rule, *never to increase the power beyond what is absolutely requisite.*

MISCELLANIES.

Bleaching Sponge.—To bleach sponge and render it perfectly white, it is necessary to soak it in cold water, but if it does not become soft, it must be immersed in boiling water. This, however, should, if possible, be avoided, for it has [illegible] effect on the sponge, particularly in cooling, [illegible] shrink and to become hard, and [illegible] ent its being [illegible] every time [illegible] off, the sponge is pressed perfectly dry; this process being repeated for five or six days, it will at the expiration of that time be ready for bleaching. If the sponge, as is frequently the case, should contain small pieces of chalk and shells, which cannot be got out without tearing it, the sponge must be soaked for twenty-four hours in muriatic acid, with twenty parts of water, which will cause an effervescence to take place, and carbonic acid gas to be liberated, when the shells and chalk will become perfectly dissolved. After that it must be carefully washed in muriatic acid and fresh water, the specific gravity of which must be 1·024. The immersion of the sponge in this acid should continue for about eight days; but it must occasionally be pressed dry and thoroughly washed. After having been perfectly washed and cleaned it should be sprinkled with rose water, to give it a pleasant smell, which completes the process.

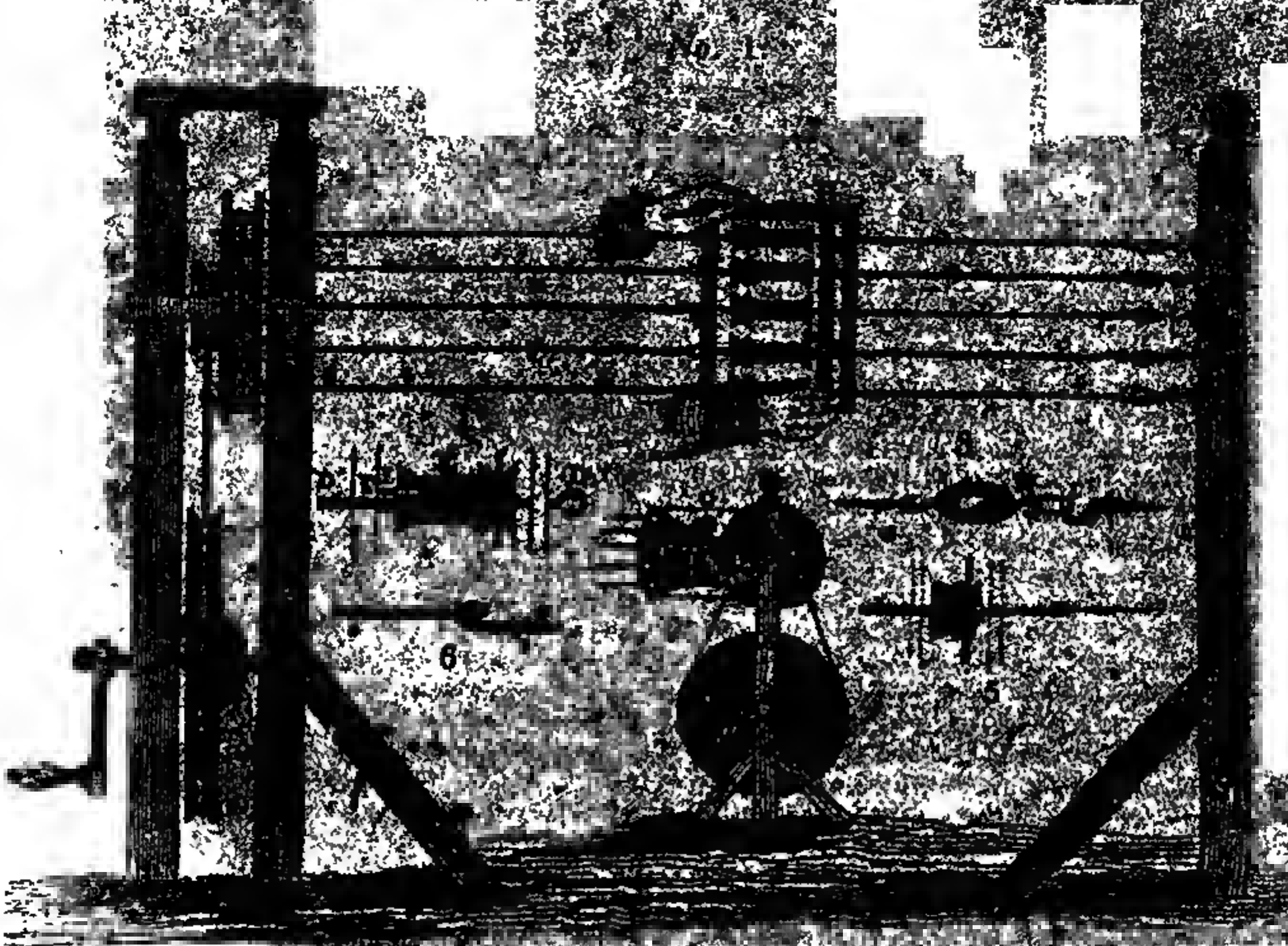
Anti-Attrition Paste.—According to the specification of the patent, this mixture consists of 1 cwt. of plumbago to 4 cwt. of hogs'-lard, or other grease, the two to be well incorporated. The application is to prevent the effects of friction in all descriptions of engines or machines; and a sufficient quantity must be rubbed over the surface of the axle, spindle, or other part where the bearing is.

Imperishable Paste.—Dr. M'Culloch, in a paper on the power of perfumes in preventing mouldiness, gives the following directions for the preparation of a paste, which will keep any length of time, and is always ready for use:—"That which I have long used in this manner is made of flour, in the usual way, but rather thick, with a proportion of brown sugar, and a small quantity of corrosive sublimate. The use of the sugar is to keep it flexible, so as to prevent its scaling off from smooth surfaces; and that of the corrosive sublimate, independently of preserving it from insects, is an effectual check against its fermentation. This salt, however, does not prevent the formation of mouldiness; but, as a drop or two of the essential oils, viz.: lavender, peppermint, anise, bergamot, &c. is a complete security against this, all the causes of destruction are effectually guarded against. Paste made in this manner, and exposed to the air, dries without change to a state resembling horn, so that it may at any time be wetted again and applied to use. When kept in a close-covered pot, it may be preserved in a state for use at all times."

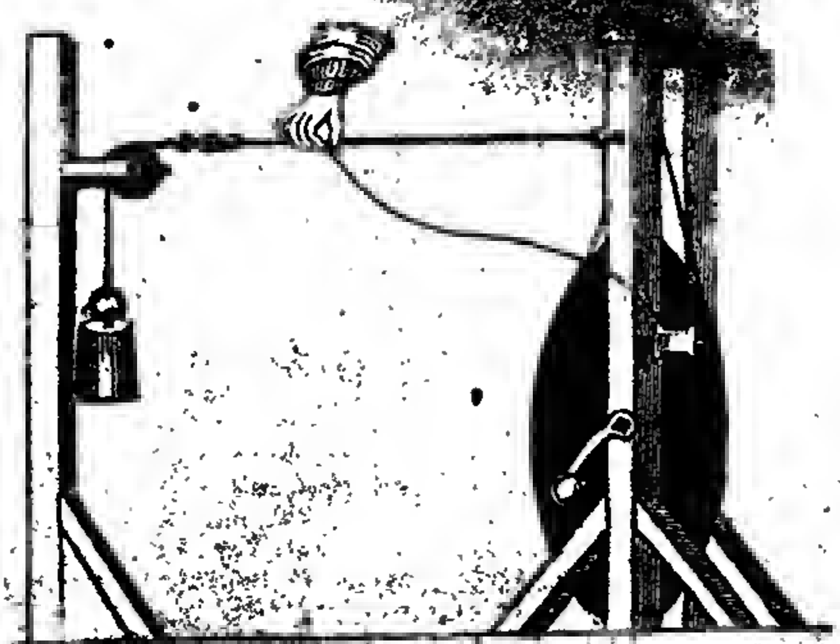
Preservation of Nuts.—Both chesnuts, walnuts, and filberts, may be preserved during the whole winter, nearly in the same state they come from the trees, by covering them with mould, as potatoes are usually covered in the gardens of cottagers, and mingling a sufficient quantity of moderately dry mould with the nuts, to occupy the space between them.

Tenacity of Vegetable Life.—An instance of this kind occurred a few days since in the Royal Park of Bus[illegible] some portion of it was broken up for the p[illegible] of ornamental culture, when immediately several flowers sprung up of the kinds which are ordinarily cultivated in gardens—this led [illegible]n investigation; and it was ascertained that this identical plot had been used as a garden not [illegible] than the time of Oliver Cromwell, more than [illegible]50 years before.

Light produced by Crystallisation.—M. Buchner having mixed some impure benzoic acid, perfectly dry, with the sixth part of its weight of vegetable charcoal, placed it on a soup plate, which was covered with a cylinder luted to it by almond paste, in such a manner that what took place in the interior could be distinctly seen through an aperture disposed for this purpose. After the whole had been exposed several days to a moderate heat, and some beautiful crystals formed, it was removed to a hotter furnace, and half an hour afterwards M. Buchner observed a brilliant flash of light in the interior of the cylinder. A succession of flashes ensued, which completely filled the cylinder, and continued half an hour; when it was taken off the furnace and examined a great quantity of crystals of benzoic acid were deposited. They resembled crystals of the same substance obtained in the usual way by a more moderate heat, and without light, except that they were less regular. M. Buchner attributed this phenomenon to a neutralisation of electricity, as it took place at a moment when the crystal was deposited on the inner surface of the cylinder. The same effect has been noticed on crystallising acetate of potassa, and in preparing oxygen by means of chlorate of potassa and manganese.



COVERING WIRE FOR GALVANIC PURPOSES, &c.



MACHINE FOR COVERING WIRE.

We have been asked so repeatedly by various correspondents as to the simplest method of covering wire with silk or cotton, that we should much neglect their wishes had we passed over the subject unnoticed; more especially as covered wire is charged at such an enormous price at the opticians. We shall first give an account of the excellent and simple machine, for which its owner, Mr. Saddington, received a premium from the Society of Arts, as described by himself in their Transactions, and afterwards represent a still more common and less expensive instrument, and for which indeed an old spinning wheel answers remarkably well; so that every person may cover wire at a most trifling expense. Mr. Saddington writes thus:—

"The present invention is an improvement on the mode of covering wire in long shops or sheds, as practised by all manufacturers who have the conveniency of such premises. The long shop covering or spinning, as it is generally termed, is by doing one length of wire at a time, yet it is the most expeditious manner of covering of any in practice, and notwithstanding the velocity with which the wire is turned round, the process of covering is very tedious, the revolutions of silk or cotton round the wire being from forty to one hundred and twenty in every inch, according to the fineness and purpose for which it is wanted. But, perhaps, the average may be fairly taken on the sizes of what is mostly used, at sixty revolutions for every inch of wire, so that each separate wire would have to perform 43,200 revolutions in a shed of only twenty yards long, and supposing the wire to be impelled round with a velocity to make fifty revolutions in every second of time, it would require more than fourteen minutes to cover a space of twenty yards in length.

"By the present invention, six wires are all covered at one time, by which improvement, a saving is gained of five-sixths of the time occupied in the act of covering, or what may be expressed more plainly, fifty minutes are gained out of every hour so employed.

"Figures 1 and 2 represent, one the side view, the other the end of the same machine, the same letters refer to both.

"The upright posts, A A, of the machine, with the multiplying wheel, are fixed to the floor at one end of the shop, and B, at the extremity of it. To A is attached an arm and fan, F, containing six grooved hooks, placed in the form of a segment of a circle, which are carried round by the multiply[illegible] wheel, D; the band is adjusted by the screw [illegible] which secures the fan to the arm. The axle of wheel D, is supported on false beds, which may [illegible] raised by small wedges to tighten the band, as occasion requires. The six brass swivels at E, are fixed to the post, B, or to a board on the wall at the opposite end of the shop, and are placed in the same form as the hooks. They have a groove in [illegible] r to keep them steady and of a proper tension, by means of a string of cat-gut passed over them, and wound round a peg; in front of [illegible] notches for the wire to work in, and to [illegible] it a pl[illegible] steady while covering."

Anti-[illegible] one of the swivels at the end E. [illegible] fication of [illegible] patent bobbins within the frame H. [illegible] cwt. of plumbago [illegible] D D the wire upon other grease, [illegible] the bent wire intended to application is to preven[illegible] cotton when uncoiling, and all descriptions of [illegible] frame. Fig. 5, one of th[illegible] pullies to which the wire is attached. Fig. 6, the wire alluded to in Fig. 4 still more increased in size.

The other machine, (and which is represented by Fig. 7,) is so simple as scarcely to need description. The cotton is guided by the band, and the wheel turned by a boy. The use of the weight is to keep the wire tight during the coiling of the cotton around it. This is the machine usually employed for covering the strings of musical instruments, such as the fourth strings of the violin, several of the harp, &c.

FRENCH POLISHING.

The method of varnishing furniture, by means of rubbing the varnish on the surface of the wood, is of comparatively modern date. To put on a hard face, which shall not be so liable to scratch as varnish, and yet appear equally fine, the French polish is introduced. The following are full details of the process,* and also the various preparations of the different compositions necessary.

All the polishes are used much in the same way; a general description will therefore be a sufficient guide for the workman. If your work be porous, or of a coarse grain, it will be necessary to give a coat of clear size previous to your commencing with the polish; and when dry, gently go over it with very fine glass-paper; the size will fill up the pores and prevent the waste of the polish, by being absorbed into the wood, and be also a saving of considerable time in the operation.

Make a wad with a piece of coarse flannel, or drugget, by rolling it round and round, over which on the side meant to polish with, put a very fine [illegible] rag several times doubled, to be as soft as possible, put the wad or cushion to the mouth of the bottle, containing the preparation (or polish) and shake it, which will damp the rag sufficiently, then proceed to rub your work in a circular direction, observing not to do more than about a square foot at a time. Rub it lightly till the whole surface is covered; repeat this thre[illegible] four tim[illegible] [illegible] the state of the wood; each coat [illegible] rubbed until the [illegible] g appears dry. [illegible] to put too much on the rag at a time [illegible] ll have a very b[illegible] utiful and [illegible] ng polish: be also [illegible] rticular in letting your rags be ver[illegible] [illegible] s the polish depends in a grea[illegible] measur[illegible] the care you tak[illegible] in keeping it cle[illegible] nd fre[illegible] dirt during the operation.

The tr[illegible] Polish.—[illegible] one pint of spirits of wine, add a quarter of an ounce of gum-copal and a quarte[illegible] ounce of gum arabic, and one ounce of shell-lac.

Let the gums be well bruised, and sifted throu[illegible] a piece of muslin. Put the spirits and the gu[illegible] together in a vessel that can be closely corked, place them near a warm stove, and frequently sha[illegible] them; in two or three days they will be dissolved; strain the mixture through a piece of [illegible] lin, keep it tight corked for use.

Another French Polish.—Take one ounce each mastic, sandarac, seed-lac, shell-lac, gum-lac, and gum-arabic; reduce them to powder, and add a quarter of an ounce of virgin-wax; put the whole into a bottle, with one quart of rectified spirit of wine; let it stand twelve hours and it will be fit for use.

To apply it, make a ball of cloth, and put on it occasionally a little of the polish; then wrap the ball in a piece of calico, which slightly touch with

linseed oil: rub the furniture hard with a circular motion, until a gloss is produced: finish in the same manner, but instead of all polish, use one-third polish to two-thirds spirits of wine.

Or, put into a glass bottle, one ounce of gum-lac, two drams of mastic in drops, four drams of sandarac, three ounces of shell-lac, and half an ounce of gum-dragon; reduce the whole to powder; add to it a piece of camphor, the size of a nut, and pour on it eight ounces of rectified spirits of wine: stop the bottle close, but take care when the gums are dissolving, that it is not more than half full; it may be placed near a gentle fire, or on a German stove; but a bath of hot sand is preferable, as avoiding all danger, the compound being so very apt to catch fire. Apply it as before.

An Improved Polish.—To a pint of spirits of wine, add, in fine powder, one ounce of seed-lac, two drams of gum-guiacum, two drams of dragon's blood, and two drams of gum-mastic; expose them, in a vessel stopped close, to a moderate heat for three hours, until you find the gums dissolved; strain it into a bottle for use, with a quarter of a gill of the best linseed oil, to be shaken up well with it.

This polish is more particularly intended for dark-colored woods, for it is apt to give a tinge to light ones, as satin-wood, or hare-wood, &c., owing to the admixture of the dragon's blood, which gives it a red appearance.

Water-proof Polish.—Take a pint of spirits of wine, two ounces of gum-benzoin, a quarter of an ounce of gum-sandarac, and a quarter of an ounce of gum-anime; these must be put into a stopped bottle, and placed either in a sand-bath or in hot water till dissolved; then strain it, and after adding about a quarter of a gill of the best clear poppy oil, well shake it up, and put it by for use.

Bright Polish.—A pint of spirits of wine, to two ounces of gum-benzoin, and half an ounce of gum-sandarac, [illegible] in a glass bottle corked, and placed in a sand-bath, or hot water, until you find all the gum dissolved, will make a beautiful clear polish for Tunbridge-ware goods, tea-caddies, &c.; it must be shaken from time to time, and when all dissolved, strained through a fine muslin sieve and bottled for use.

Polish for Turner's Work.—Dissolve sandarac in spirits of wine, in the proportion of one ounce of sandarac to half a pint of spirits; next shave bees' wax one ounce, and dissolve it in a sufficient quantity of spirits of turpentine to make it into a paste: add the former mixture by degrees to it; then with a woollen cloth apply it to the work while it is in motion in the lathe, and with a soft linen rag polish it; it will appear as if highly varnished.

Prepared Spirits.—This preparation is useful for finishing after any of the foregoing receipts, as it adds to the lustre and durability, as well as removing every defect which may happen in the other polish; and it gives the surface a most brilliant appearance.

Half a pint of the very best rectified spirits of wine, two drams of shell-lac, and two drams of gum-benzoin. Put these ingredients in a bottle, and keep it in a warm place till the gum is all dissolved, shaking it frequently; when cold, add two tea-spoonsful of the best clear white poppy oil; shake them well together, and it is fit for use.

This preparation is used in the same manner as the foregoing polishes, but, in order to remove all dull places, you may increase the pressure in rubbing.

Strong Polish.—To be used in the carved parts of cabinet work with a brush, as in standards, pillars, claws, &c.

Dissolve two ounces of seed-lac and two ounces of white rosin in one pint of spirits of wine.

This varnish or polish must be laid on warm, and if the work can be warmed also, it will be so much the better; at any rate moisture and dampness must be avoided.

OIL PAINTING.

(Resumed from page 342, and concluded.)

Brown ochre mixed with the color of the light is the most useful color in general for all reflects in draperies that are produced from their own colors. There are but two reflecting tints wanted for draperies in general; one should be lighter than the middle tint, the other darker.

Blue Satins.—Blue satin is made of Prussian blue and white; the first lay of colors for blue is divided into three degrees or tints. First, make the middle tint of a beautiful azure; then mix the color for the light, about a middle degree between that and white; make the shade tint dark enough for the shadows in general. All the broad lights should be laid with plenty of color, and shaped to character with the middle tint before you lay on other colors. The shadows should be strengthened with ivory black, and some of their own colors. The reflects are made as those of white satin, that is, with ochre and some of the lights, which should be perfectly done at one painting as you intend them.

Velvets.—Velvet may be painted at once. The method is to make out the first lay with the middle tint and shade tint, on which lay the high lights with light touches, and finish the shadows in the same manner as those of white satin.

Scarlet and Crimson.—A light yellow red, made of light ochre, light red, and white, is the proper ground for scarlet; the shadows are Indian red, and in the darkest parts mixed with a very light black. The high lights are vermillion and white, for satin and velvet, and vermillion for cloth. Their reflects are made with light red and vermillion.

Yellow.—There are the same number of tints in the yellow as there are in the white satin, and the method of using them is the same. The lights are made with chrome or King's yellow; the first tint is light ochre—the middle tint is a mixture of the light and brown ochre—the shade tint is made with brown pink and brown ochre. The reflects are light ochre. The shadows are strengthened with brown pink and brown umber.

Green.—The ground for green is a light yellow green. The high lights are chrome or king's yellow and a very little Prussian blue. The middle tint should have more Prussian, and the shade tint is made of some of the middle tint, brown pink and more Prussian; but the darkest shadows are brown pink and a little Prussian.

Blacks.—The best ground for black is light red for the lights, and Indian red and a little black for the shadows; the finishing colors are—for the lights, black, white, and a little lake; the middle tint has less white and more lake and black; the shade tint is made of an equal quantity of lake and brown pink with a very little black. The method of painting black is different from that of other colors, for as in these the principal thing is to leave their lights clear and brillant, so in black

it is to keep the shadows clear and transparent. Therefore, begin with the shade tint and glaze over all the shadows with it. Next lay in the darkest shadows with black and a little of the shade tint very correctly; after that fill up the whole breadth of lights with the middle tint only; all which should be done exactly to the character of the satin, velvet, cloth, &c., and then finish with the high lights.

ON PAINTING BACK GROUNDS.

The principal colors necessary for painting back grounds, as walls, buildings, &c., are white, black, Indian red, light and brown ochre, Prussian blue, and burnt umber, from which the eight principal tints are made as follows:—

1. *Pearl.*—Made of black, white, and a little Indian red.

2. *Lead.*—Of black and white.

3. *Yellow.*—Of a brown ochre and white.

4. *Olive.*—Of light ochre Prussian blue, and white.

5. *Flesh color.*—Of Indian red and white, mixed to a middle tint.

6. *Murrey.*—Of Indian red, white, and a little black, mixed to a kind of purple of a middle tint.

7. *Stone Color.*—Of white umber, black, and Indian red.

8. *Dark shade.*—Of black and Indian red.

Painting of back grounds is divided into two parts, the first lay and the finishing tints. In the first lay the student is to begin from the shadowed side of the head and paint the lights first. From thence go to the gradations and shadows, which should be done with a large tool of middling stiffness, very sparingly with the dark shade and white, a little changed with the colors that will give it more of the required hue. The dark and warm shadows should be laid before the colors that join them.

The second part is to follow directly while the first lay is wet, with those tints that are proper to harmonize and finish with, begin with the light, and heightening and finishing with warmer colors. From the lights the next step is to the gradations and shadows. The whole must then be blended and softened with a long large tool. Remember the tints will sink and lose a little of their strength and beauty in drying. All grounds, as walls, &c., should be finished at one painting, but if any alterations should be required they may be glazed with a little of the dark shade and drying oil driven very bare. The dark shadows may likewise be strengthened and improved by glazing. Rembrandt's grounds are rather brighter in the lights, and have more variety of tints than other painters. He understood the gradations in perfection, by mixing and breaking the first lay of colors so artfully, that they deceive in regard to their real strength. Vandycke's general method was to break the colors of the ground with those of the drapery. Curtains should be dead colored when we paint the ground, and should be done with clean colors, of a near hue to the intended curtain. The sky should be broke with the lead and the flesh tints. The murrey tint is of great use in the grounds of distant objects, and the umber and dark shades in the near grounds. After all is painted go over the whole very lightly with the softener, as you did the grounds, which will make it look agreeably finished.

CHEMICAL ACTION.

(Resumed from page 351, and concluded.)

Ex. 30.—*Gases formed from a Liquid.*—Put some damp ashes upon a hot fire, and a blue flame will be seen playing upon the top of them, showing that the water has been decomposed into its two constituent gases, oxygen and hydrogen. The former goes to feed the fire, the latter is liberated, and burns at the top. When water is decomposed by galvanism, both gases are obtained.

Ex. 31.—Let nitric acid pass slowly through a red-hot earthenware tube, and it will be decomposed—giving off oxygen gas, and nitrous oxyde gas; and thus here also two gases have been formed from a liquid.

Ex. 32.—*Change of Temperature and Specific Gravity.*—Mix together like measures of strong sulphuric acid and of water. The mixture will not only be less in quantity than the two separately, but the heat so great as to be above that of of boiling water.

Note.—To show this in a satisfactory manner in a lecture room, it is customary to employ a tube with a double globe, (as figured below.) To use it, fill the stem, and one ball with strong sulphuric acid, and the upper ball with water; cork it, and turn it upside down. The diminution of vo[illegible] when the water and acids are thus mixed together will be seen in the tube.

Ex. 33.—*Two Pints may be less than a Quart.* Into a quart measure put a pint of spirits of wine, and [illegible] a pint of water; stir them together, they will become warm, but not fill the measure.

Ex. 34. — *Clearing away of Snow by Salt.*—Mix together equal parts of snow and salt. The two will unite and form a liquid — colder than either of the two before mixing.

Note.—Salt is often sprinkled upon snow to clear the pathways, &c. So great a degree of cold is produced by the mixture, that if not swept off immediately the brine that remains will penetrate the shoes, and chill the feet of the traveller, infinitely more than the snow would have done.

Ex. 35.—*Change of Color.*—To a solution of galls add a solution of sulphate of iron, both nearly colorless, and black ink will be formed; add some hydrochloric acid, the black color will disappear, and the solution become colorless again.

Ex. 36.—Make a very weak solution of sulphate of copper, and add to it liquid ammonia: it will become of a most beautiful blue color, such as we see in the shop windows of the chemists

Ex. 37. *Change of Taste.*—Sulphuric acid is in the highest degree sour and corrosive—potass has an extremely nauseous alkaline taste. Mix these together, and they will make the nearly tasteless sulphate of potass.

Ex. 38.—*Change of Smell.*—Nitric acid has a most pungent odour, and liquid ammonia not less so. Mix these together in such proportions that they neutralize each other—a perfectly scentless salt will be obtained, the nitrate of ammonia. Ammonia itself, though so pungent in odour, is formed from two scentless gases, hydrogen and nitrogen.

Ex. 39.—Pound in a mortar, or rub together on a board, a small piece of lime, and an equal quantity of sal-ammoniac. They will unite, and although separately they have no scent, yet when combined a powerful odour of smelling salts will be given off.

The above experiments exhibit chemical action under numerous of its phases, showing how different are the causes which produce it, and at the same time how contradictory, and often unexpected, is the result of chemical combination and decomposition. An explanation of each operation would have been premature, and, except to the chemist, unintelligible, until the nature and peculiar characteristics of the chemical elements had been pointed out and compared; they will then form a subject of future consideration.

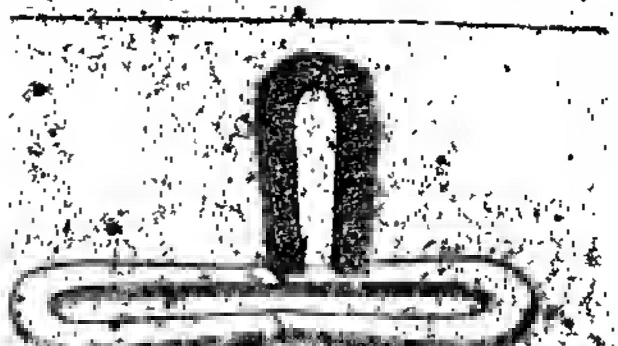
MAKING ARTIFICIAL MAGNETS.

(Resumed from page 349, and concluded.)

Horse-shoe Magnets.—Horse-shoe magnets are those which have the form of a horse-shoe; and this form is, generally speaking, the most convenient for use, and for the preservation of their magnetic power. In all experiments where a large weight is to be lifted, the horse-shoe magnet is indispensable; and in consequence of the two poles being brought together, they may be substituted with great advantage for magnetising steel bars by the method of double touch.

In order to form a powerful magnetic battery, the best way is to unite a number of similar horse-shoe magnets, with their similar poles together, and to fix them firmly together in a case of copper or leather. The following is the method recommended and used by Professor Barlow:—He took bars of steel twelve inches long, and having bent them into the horse-shoe shape, their length was six inches, their breadth one inch at the curved part, and three-fourths of an inch at their extremities, and their thickness one-fourth of an inch. They were filed very nicely, so as to correspond and lie flatly upon each other. They were drilled with three holes in each; by means of screws passing through these holes, *nine* horse-shoe bars were bound together. When the heads and ends of the screws were constructed, so as to leave the outer surfaces smooth, the mass of bars was filed as if they were one piece, and the surface made flat and smooth. When the bars were separated they were carefully hardened, so as not to warp, and when they had been well cleaned and rendered bright, but not polished, they were magnetised separately in the following manner:—

When the two extremities of the bar are connected by a piece of soft iron, the magnetism may be developed in the two halves by Duhamel's method, as in the annexed figure; or, following Æpinus, we may apply a strong magnet to each pole, and connect their extremities, either with a piece of soft iron or another magnet, or we may apply two horse-shoe magnets to each other, as in the annexed figure, uniting the poles which are to be of contrary names.



When the magnet or magnets are prepared in any of these ways, they are then to be magnetised with another horse-shoe magnet, by placing its north next to what is to be the south pole of one of the horse-shoe bars, and then carrying the moveable magnet round and round, but always in the same direction. In this way a very high degree of magnetic virtue may be communicated to each of the *nine* bars. When this is done they are to be reunited by the three screws, and their poles or extremities connected by a piece of soft iron, or *lifter*, having at its middle a hook for suspending any weight. As the lifting power depends on the accurate contact of the poles of the magnets with the lifter, the extremities should, after hardening, be properly rubbed down with putty upon a flat surface.

A magnet of this size and form was found by Professor Barlow to suspend *forty pounds*; but he afterwards found that a greater proportional power could be obtained by using bars that were long in comparison with their breadth.

Professor Barlow's Method.—The following method of making artificial magnets is both a simple and efficacious one, and has been practised successfully by Professor Barlow. Having occasion for thirty-six magnets, twelve inches long, one and a fourth broad, and seven-sixteenths of an inch thick, he placed thirty-six bars of steel, of these dimensions on a table, so as to form a square, having nine bars on each side, the marked or north pole of each bar being in contact with the unmarked or south pole. At the angular points of the square the inner edges of the bars were brought into contact, and the external opening thus left was filled up by a piece of iron one inch and a quarter square and seven-sixteenths of an inch thick. The horse-shoe-magnet described in the preceding section was set upon one of the bars, so that its north pole was towards the unmarked end of the bar, and was then carried or rubbed along the four sides of the bars; and the operation was continued till the horse-shoe magnet had gone twelve times round the square. Without removing the magnet, each bar was turned one by one, so as to turn their lower sides uppermost, and the horse-shoe magnet was made to rub along the four sides of the square other twelve times. The bars were then highly magnetised; and the whole process did not occupy more than half an hour.

Knight's Method, or *Iron Paste Magnets.*—Although the following method of making a magnetic paste has been given in almost every treatise on magnetism, and was kept a secret by its inventor, yet we have no distinct information that it has been found superior in any respect to steel as a vehicle of magnetism. Mr. Benjamin Wilson communicated the method to the Royal Society after the death of Mr. Knight.

Having provided himself with a large quantity of clean filings of iron, Dr. Knight put them into

a tub that was more than one-third full of clean water; he then, with great labour, worked the filings to and fro for many hours together, that the friction between the filings of iron by this treatment might break off such small parts as would remain suspended in the water for some time; the obtaining of which very small particles in sufficient quantity, seemed to him to be one of the principal desiderata in the experiment. The water being by this treatment rendered very muddy, he poured it into a clean earthen vessel, leaving the filings behind; and when the water had stood long enough to become clean, he poured it out carefully, without disturbing such of the iron sediment as still remained, which was now reduced to an almost impalpable powder. This powder was afterwards removed into another vessel, in order to dry it; but as he had not obtained a proper quantity of it by this first step, he was obliged to repeat the process many times. Having at last procured enough of this very fine powder, the next thing to be done was to make a paste of it, and that with some vehicle which could obtain a considerable quantity of the phlogistic principle. For this purpose he had recourse to linseed oil in preference to all other fluids. With these two ingredients only he made a stiff paste, taking particular care to knead it well before he moulded it into convenient shapes. Sometimes, while the paste continued in its soft state, he would put the impression of a seal on several pieces, one of which is in the British Museum. This paste was then put upon wood, and sometimes on tiles, in order to bake or dry it before a moderate fire, at about a foot distance. The Doctor found that a moderate fire was most proper, because a greater degree of heat made the composition frequently crack in many places.

"The time necessary for baking this paste was generally five or six hours before it attained a sufficient degree of hardness. When that was done, and the several baked pieces were become cold, he gave them their magnetic virtue in any direction he pleased, by placing them between the extreme ends of his magazine of artificial magnets, for a few seconds or more, as he saw occasion. By this method the virtue they acquired was such, that when any one of these pieces was held between any of his best ten-guinea bars, with its poles purposely inverted, it immediately of itself turned about to recover its natural direction, which the force of these very powerful bars was not sufficient to counteract." After giving the preceding method, M. Biot remarks, that it consist in procuring a very fine powder of iron a little oxidated, all the particles of which he united by means of linseed oil, or any other substance fitted to give them a proper degree of oxygenation. "When this paste was magnetised," he continues, "each particle of the powder became a small magnet, in which the development of the magnetism might be very powerful, on account of the suitable degree of coercive powder produced by the oxygenation; and the homogeneity of this state in all the particles, as well as their extreme tenuity, might give to the whole system the most favorable arrangements for receiving a high degree of magnetism." M. Biot conceives that a somewhat analogous effect might be obtained by steel of an equal and homogeneous grain, the carbon giving a coercive power like oxygen; but he thinks that the paste is likely to form better magnets. He is of opinion also that some powerful natural magnets may owe their virtue to the union of similar qualities.

Dr. Fothergill, who had seen Mr. Knight's paste magnets in his own possession, says, that the mass had the appearance of a piece of black lead, though less shining. He informs us also of a very remarkable fact, if it be true, that while the poles of a natural loadstone, or of the hardest steel magnet, could be changed, those of the paste magnets were immoveable. A small piece, of about half an inch square and one-fourth thick, was powerfully magnetic though unarmed; and its poles could not be altered though it was placed between two of Mr. Knight's largest and most strongly impregnated magnetic bars.

Conceiving that the powder which formed the basis of this paste was the *black oxyde of iron*, or *martial Ethiops*, M. Cavallo has given the following receipt for imitating natural magnets; but he does not say that the magnets made by it are better than those of steel. "Take some martial Ethiops reduced into a very fine powder, or, which is more easily procured, *black oxide of iron*, the scales which fall from red-hot iron when hammered, and are found abundantly in smiths' shops. Mix this powder with drying linseed oil, so as to form it into a very stiff paste, and shape it in a mould so as to give it any form you require, whether of a terella, a human head, or any other. This done, put it into a warm place for some weeks, and it will dry so as to become very hard; then render it magnetic by the application of powerful magnets, and it will acquire a *considerable* power."

ACTION AND RE-ACTION.

From "Dr. Arnott's Physics.

"Action and re-action are equal and contrary."

If a man in one boat pull at a rope attached to another the two boats will approach. If they be of equal size and load, they will both move at the same rate, in whichever of the boats the man may be; and if there be a difference in the sizes and resistances, there will be a corresponding difference in the velocities, the smaller boat moving the fastest.

A magnet and a piece of iron attract each other equally, whatever disproportion there is between the masses. If either be balanced in a scale, and the other be then brought within a certain distance beneath it, the very same counterpoise will be required to prevent their approach, whichever be in the scale. If the two were hanging near each other as pendulums, they would approach and meet; but the little one would perform more of the journey in proportion to its littleness.

A man in a boat pulling a rope attached to a large ship, seems only to move the boat; but he really moves the ship a little, for, supposing the resistance of the ship to be just a thousand times greater than that of the boat, a thousand men in a thousand boats, pulling simultaneously in the same manner, would make the ship meet them half way.

A pound of lead and the earth attract each other with equal force, but that force makes the lead approach sixteen feet in a second towards the earth, while the contrary motion of the earth is of course as much less than this, as the earth is weightier than one pound,—and is therefore unnoticed. Speaking strictly, it is true, that even a feather falling lifts the earth towards it, and that a man jumping kicks the earth away.

A spring unbending between two equal bodies, throws them off with equal velocity; if between bodies of different magnitudes, the velocity of the smaller body is greater in proportion to its smallness.

On firing a cannon, the gun recoils with even more motion or momentum in it than the ball has, for it suffers the re-action of the expelled gun-powder as well as of the ball; but the momentum in the gun being diffused through a greater mass, the velocity is small and easily checked.

The recoil of a light fowling piece will hurt the shoulder, if the piece be not held close to it.

A ship in chase, by firing her bow guns, retards her motion; by firing from her stern she quickens it.

A ship firing a broadside, heels or inclines to the opposite side.

A vessel of water suspended by a cord hangs perpendicularly; but if a hole be opened in one side, so as to allow the water to jet out there, the vessel will be pushed to the other side by the re-action of the jet, and will so remain while it flows. If the hole be oblique, the vessel will constantly turn round.

A vessel of water placed upon a floating piece of plank, and allowed to throw out a jet, as in the last case, moves the plank in the opposite direction.

A steam-boat may be driven by making the engine pump or squirt water from the stern, instead of making it, as usual, move paddle-wheels. There is a loss of power however in this mode of applying it.

A man floating in a small boat, and blowing strongly with a bellows towards the stern, pushes himself onwards with the same force with which the air issues from the bellows pipe.

A sky-rocket ascends, because, after it is lighted, the lower part is always producing a large quantity of aeriform fluid, which, in expanding, presses not only on the air below, but also on the rocket above, and thus lifts it. The ascent is aided also by the recoil of the rocket from the part of its substance, which is constantly bursting downwards.

He was a foolish man who thought he had found the means of commanding always a fair wind for his pleasure-boat, by erecting an immense bellows in the stern. The bellows and sails acted against each other, and there was no motion: indeed, in a perfect calm, there would be a little backward motion, because the sail would not catch all the wind from the bellows.

A man supported on a floating plank by walking towards one end of it gives it a motion in the direction opposite.

A man using an oar, or a steam-engine turning paddle-wheels, advances exactly with the force that drives the water astern.

A swimmer pressing the water downwards and backwards with his hands, is sent forwards and upwards with the same force, by the re-action of the water.

And a bird flying, is upheld with exactly the force with which it strikes the air in the opposite direction.

A man pushing against the ground with a stick, may be considered as compressing a spring between the earth and the end of his stick, which spring is therefore pushing him up as much as he pushes down; and if, at the time, he were balanced in the scale of a weighing beam, he would find that he weighed just as much less as he were pressing with his stick.

Thus an invalid, on a spring plank or chair, who by a trifling downward pressure of his hand on a staff or on a table, causes his body to rise and fall through a great range, and thus obtains the advantage of almost passive exercise, is really lifting himself while he presses downwards.

When a boy cries, on knocking his head against a table or pane of glass, he is commonly told, and truly, that he has given as hard a blow as he has received; although his philosophy, probably looking chiefly to results, blames the table for his head hurt, and his head for the glass broken.

The difference of momentum acquired in a fall of one foot, or of several, is well known: the corresponding intensities of re-action are unpleasantly experienced by a man who sits down in an easy chair, or who, in sitting down where he supposed a chair to be, unexpectedly reaches the floor.

What motion the wind has given to a ship, it has itself lost, that is to say, the ship has re-acted on the moving air; as is seen when one vessel is becalmed under the lee of another.

When one billiard ball strikes directly another ball of equal size, it stops, and the second ball proceeds with the whole velocity which the first had—the action which imparts the new motion being equal to the re-action which destroys the old. Although the transference of motion in such a case seems to be instantaneous, the change is really progressive, and as follows. The approaching ball, a certain point of time, has just given half of its motion to the other equal ball, and if both were of soft clay, they would then proceed together with half the original velocity; but as they are elastic, the touching parts at the moment supposed are compressed like a spring between the balls, and by then expanding, and exerting force equally both ways, they double the velocity of the foremost ball, and destroy altogether the motion of that behind.

If a billiard-ball be propelled against the nearest one of a row of balls equal to itself, it comes to rest as in the last case described, while the farthest ball of the row darts off with its velocity,—the intermediate balls having each received and transmitted the motion in a twinkling, without appearing themselves to move.

As further illustrative of the truths, that action and re-action are equal and contrary, and that in every case of hard bodies striking each other, they may be regarded as compressing a very small strong spring between them, we may mention, that when any elastic body, as a billiard-ball, strikes another body larger than itself, [illegible] rebounds, it gives to that other, not only all the motion which it originally possessed, this [illegible] done at the moment when [illegible] to rest, but an additional quantity, equal [illegible] that with which it recoils—owing to the eq[illegible] both di[illegible]tions of the repulsions or spring [illegible] the recoil. When the difference of size between the bodies is very great, the returning velocity of the smaller is nearly as great as its advancing motion was, and thus it gives a momentum to the body struck, nearly double of what it originally itself possessed. This phenomenon constitutes the paradoxical case of an effect being greater than its cause, and has led persons imperfectly acquainted with the subject, to seek from the principle, a *perpetuum mobile*. A hammer on rebounding from an anvil has given a blow of nearly double the force which it had itself, for the anvil felt its full original force while stopping it, and then, equally with itself, was affected by the repulsion which caused its return.

Many other interesting facts might be adduced as examples of equal action and re-action, but these will suffice.

PROJECT FOR A QUICKER CONVEYANCE OF LETTERS

Let us imagine a series of high pillars erected at frequent intervals, perhaps every hundred feet, as nearly as possible in a straight line between the two post towns. An iron or steel wire of some thickness must be stretched over proper supports fixed on each of these pillars, and terminating at the end of every three or five miles, as may be found expedient, in a very strong support, by which it may be stretched. At each of these latter points a man ought to reside in a small station-house. A narrow cylindrical tin case, to contain the letters, might be suspended by two wheels rolling upon this wire;—these might be so constructed as to enable them to pass unimpeded by the fixed supports of the wire. An endless wire of much smaller size must pass over two drums, one at each end. This wire should be supported on rollers fixed to the supports of the great wire, and a little below it. With this arrangement there would be two branches of the smaller wire always accompanying the larger one, and the attendant at either station might, by turning the drum, cause these two branches of the small wire to move with great velocity in opposite directions. In order to convey the cylinder which contains the letters, it would be necessary to attach it by a string, or by a catch, to either of the branches of the smaller wire. Thus it would be conveyed speedily to the next station, where it would be removed by the next attendant to the commencement of the next wire, and thus transmitted on. It is unnecessary to enter into the details which this, or any similar plan, would require. These difficulties are obvious; but if these were overcome, it would present many advantages beside velocity; for if an attendant reside at each station, the additional expense of having two or three deliveries of letters every day, and even of sending expresses at any moment, would be comparatively trifling; and it is not impossible that the stretched wire might itself be available for a species of telegraphic communications still more rapid.

Perhaps if the steeples of churches, properly selected, were made use of in connecting them with a few intermediate stations with some great central building, as, for instance, with the top of St. Paul's, and if a similar apparatus were placed on the top of each steeple, and a man to work it during the day, it might be possible to diminish the expense of the twopenny post, and make deliveries every half hour over the greater part of the metropolis.—*Babbage's "Economy of Machinery and Manufactures."*

CALORIC FROM WATER

It is known that a mixture of two parts of oxygen gas, and of one of hydrogen, (the initial temperature being communicated to it,) will inflame, and develope sufficient caloric to burn the diamond. It is also known, that, by means of a voltaic battery, to each pole of which is united a thread of platina, the electric fluid, being forced to enter a glass tube full of water, produces a developement of gas in both the ends of the tube; that connected with the negative pole, being hydrogen gas, and double in quantity to that produced by the positive pole, which is oxygen. Now the query is, may not an apparatus similar to that of the voltaic pile, or some other mech[illegible] found; which [illegible] acting on a mass of water, may [illegible] the oxy-gen and hydrogen gas, thus disengaged be collected in immense receivers; some (those for the hydrogen gas) double the size of the others, (for the oxygen gas), thus procuring for any one, economically, and at will, in any part of the earth, volumes of combustible materials, and eminently calorific?

TELESCOPE AND MICROSCOPE

To the Editor.

Sir,—On the wrapper of Part X, of the "Magazine of Science," in reply to a correspondent, you observe,—"you cannot make the same instrument serve as a microscope and a telescope also." Now, Sir, as the image of an object viewed by a telescope is formed in the tube, at the focus of the object glass, more or less perfect, according to the goodness of the object glass, which image being magnified by the eye glasses,—the eye glasses may, therefore, be made use of as a microscope in a very effectual and pleasing way, for any transparent object, such as the cuttings of wood, wings of flies, small insects, &c. &c., which I shall here endeavour to show: and be it observed, that the eye [illegible] in the best telescopes are so constructed with respect to their curves, foci, distances, &c. [illegible] a magnifying power of the best possible [illegible] tion, consequently the best for rendering [illegible] viewed by it distinct.

The mode I have adapted for using the eye [illegible] of my telescope as a microscope is [illegible]

The instrument is a [illegible] with three brass slides, [illegible] slides at the end of the second tube [illegible] ture on each side of it, exactly [illegible] and close to the lower eye glass [illegible] the ivory slide. Let the slide [illegible] that the object shall be exactly [illegible] the eye glass, put up the br[illegible] to keep the ivory slide [illegible] through the eye tube up[illegible] not at the sun, which [illegible] horse, or look at the [illegible] little distance [illegible] proper focal distance [illegible] distinctly you will then have [illegible] magnified view of the object [illegible] of the compound microscope [illegible] much more easily managed at all times [illegible] requiring no adjustments [illegible] the sun when [illegible] It does not of course answer for opaque objects.

If the eye tube is to be constructed as they generally are, that the two first eye glasses draw out from the two second, if they are partly drawn out and retained in that position, the magnifying power is increased, the focal distance being shortened.

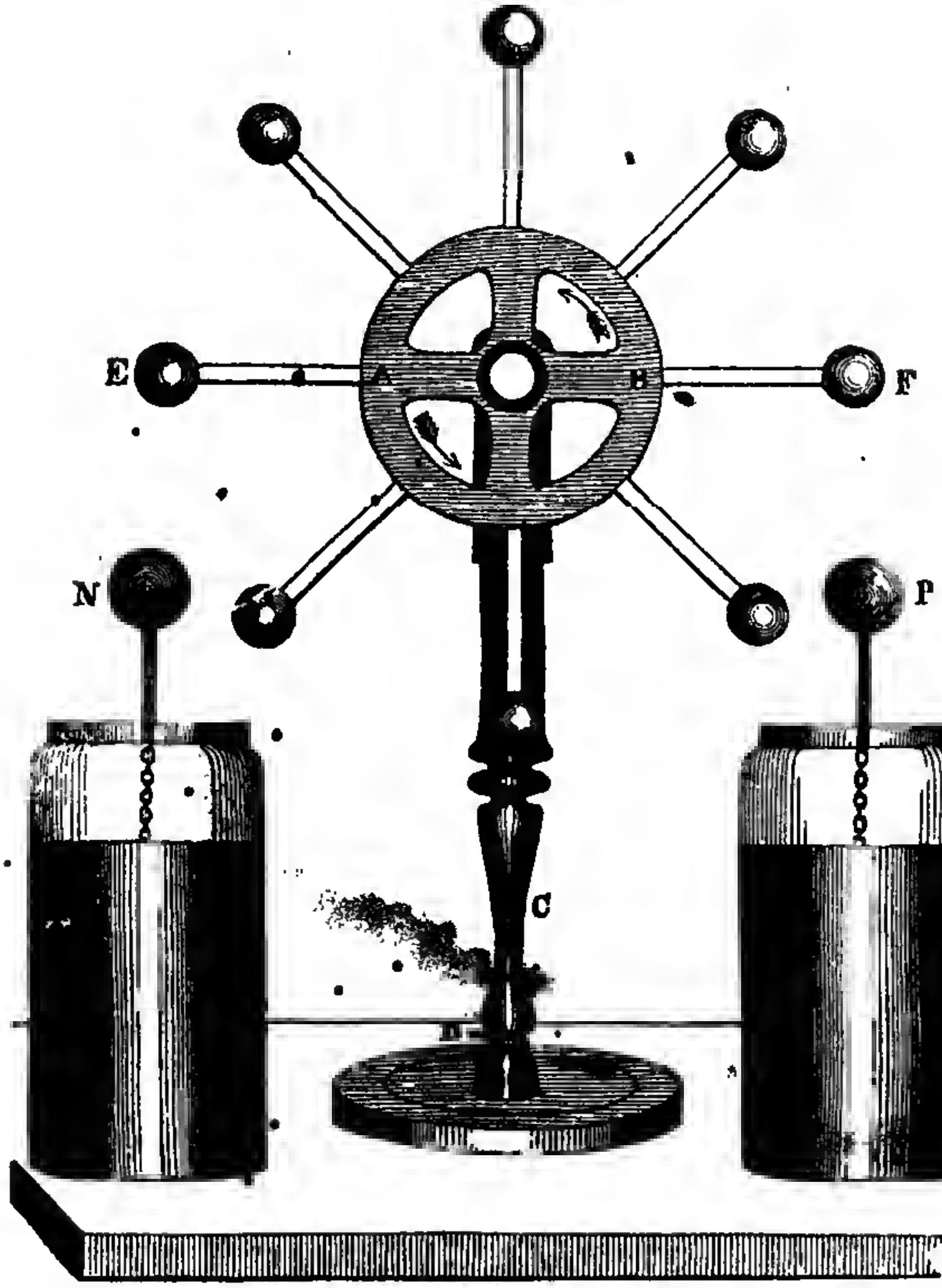
If the ivory slides are made sufficiently thick so as to admit of two thin bits of glass instead of [illegible] it is much better, clearer, free from scratches [illegible] &c., and, in the latter case, a rim of fine [illegible] be inserted between the two glasses, so as to admit of minute insects being inserted between them, without killing or injuring the insects.

I am, Sir, yours, &c. C. M. H.

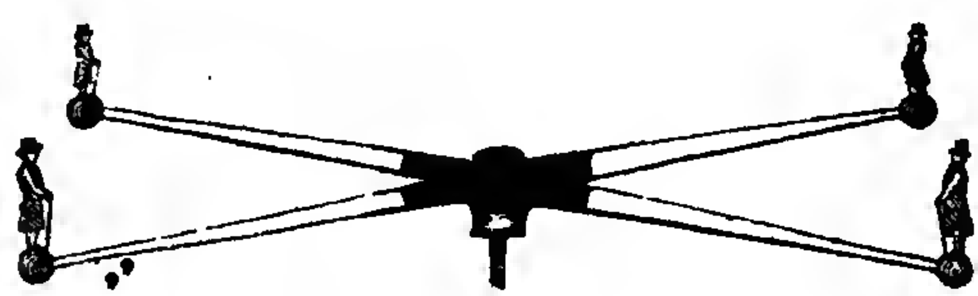
Charmouth, Dorset, Feb. 11th, 1840.

[*Note.*—The above must be considered a toy, rather than a scientific instrument. Our correspondent may, if he pleases, cut holes in telescope tubes, but we strongly advise our other friends to refrain from doing so.—Ed.]

Fig. 1.



ELECTRICAL EXPERIMENTS.



2.

To the Editor.

SIR.—Finding that your Magazine gives full scope to tha pleasing science of Electricity, I send the following new experiments, presuming that they will be acceptable to soma of your readers.

P. WAGSTAFF.

Tha following experiments depend chiefly upon the construction of a wheel, called "*The Vertical Discharging Wheel,*" which is as follows :—A B is a piece of light, close-grained wood, ½ an inch thick, 4½ inches diameter. Eight holes are hored in the circumference, ¾ of an inch deep, 3-16tha wide, in which are fixed eight stems of solid glass, 3½ inches long: on tha other end of the stems are cemented hollow brass halls. Fix the wheel either vertically, as in the drawing, Fig. 1, or else horizontally, in either case free to move round on its centre, and with little friction. To put the wheel in motion, get two quart Leyden jars, with covers and halls. Charge the jar P at the positive conductor, and the jar N at the negative. Set them so, that the halls of the wheel will just pass tha halls of the jars. Giva the wheel a trifling impulse with the finger; the hall F is attracted hy P—it receives a spark—is then repelled, and moves on until it is attracted by N, when it gives a spark—is again repelled—so that each hall is twica attracted—and twice repelled, in each revolution. Tha velocity increases, and continues until the power of the electricity is not greater than ths resistance it meets with. If the table is not a conductor, a wire or chain must be laid between the jars.

In the above it is to he supposed, that the wheel is fixed to a wire, which runs down a hola hored in the upright part of the stand C, and resting at tha lower end upon a plug of hrass, driven into the stand at D, or it may ba inserted into tha bottom of the stand. The reason of this adjustment, which it will be seen is not necessary for tha success of tha experiment, is that the wheel may be removed at pleasure, and another substituted.

The Horizontal Discharging Wheel.—French "Dictionnaire Methodique," is one repre-sented exactly similar to the abova, but working horizontally, and this, though perhaps not snch an imposing experiment, is more successful, as tha friction of its action is generally less, working as it does upon a fine point.

Fig 2 exhibits a wheel of this description. The central portion is of hard wood, with the wira which is to hear it below, and four short brass tubes, (there may be any number,) into each of which a solid glass rod is inserted, hearing a ball with figure at its outer extremity. Upon tha same principle as before, each hall is alternately attracted and repelled, when placed in a proper position between tha charged jars. Many modifications of these experiments may he made, all of them subservient to amusement. For axample—the vertical wheel may represent a windmill, a water mill, a tread mill, a train of wheel-work, or may work a pasteboard model of a pnmp. The horizontal wheel may, hy carrying round with it a clapper, strike a set of bells, properly arranged, and for many other purposes, which will readily suggest themselves to the ingenious. Thongh be it observed, that for some of these it is requisite that the machine should be kept in motion, that the jars may never lose except a small portion of their charge; for it will be found that it is the intensity of the charge which influences the degree of attraction and repulsion, and not quantity; thus with a larga battery, weakly charged, the experiments will not succeed, but with small jars fully charged, the success is certain.

Wheels of the above description will also act when made, placed properly between the prime conductor and the gronnd, so that each hall in the revolution of the wheel may convey downwards a small portion of fluid. And still more rapid will he their motion if placed hetween two halls; placed the one on the negative, tha other on the positive conductors of a machine in action.

PHENOMENA OF SPRINGS.

EVERY one is familiar with the fact, that certain porous soils, such as loose sand and gravel, absorb water with rapidity; and that the ground composed of them soon dries up after heavy showers. If a well he sunk in such soils, we often penetrate to considerable depths before we meet with water; but this is usually found on our approaching the lower parts of the formation, where it rests on some impervious bed; for here the water, unabla to make its way downwards in a direct lina, accumulates as in a reservoir, and is ready to ooza out into any opening which may he made, in tha same manner as we see the salt water flow into, and fill, any hollow which we dig in the sands of the shore at low tide.

The facility with which water can percolate loose and gravelly soils is clearly illustrated hy the effect of the tides in the Thames between Richmond and London. The river, in this part of its course, flows through a bed of gravel overlying clay, and the porous superstratum is alternately saturated by the water of the Thames, as the tide rises, and then drained again to the distance of several hundred feet from the hanks when the tide falls, so tha wells in this tract regularly ebb and flow.*

If tha transmission of water through a porous medium be so rapid, we cannot be surprised that springs should ha thrown out on the side of a hill, where the upper set of strata consist of chalk, sand, or other retentiva soils. The only difficulty, indeed, is to explain why the water does not ooza out everywhere along the line of junction of the two formations, so as to form one continuous land-soak, instead of a faw springs only, and thesa far distant from each other. The principal cause of this concentration of the waters at a few points is, first, the frequency of rents and fissures which act as natural drains; secondly, the existence of inequalities in the upper surface of the impermeable stratum, which lead the water, as valleys do on the external surface of a conntry, into certain low levels and channels.

That the generality of springs owe their supply to the atmosphere is evident from this, that they become langnid, or entirely cease to flow, after long droughts, and are again replenished after a continuance of rain. Many of them are probahly indebted for the constancy and uniformity of their volume to the great extent of the subterranean reservoirs with which they commnnicate, and tha time reqnired for these to empty themselves hy percolation. Snch a gradual and regulated discharge is exhibited, though in a less perfect degree, in every great lake which is not sensibly affected in its level by sudden showers, but only slightly raised; so that its channel of efflux, instead of

being like the bed of a torrent, is enabled to carry off the surplus water gradually.

Much light has been thrown, of late years, on the theory of "Artesian wells," so called because the method has long been known and practised in Artois; and it is now demonstrated that there are sheets, and, in some places, currents of fresh water, at various depths in the earth. The instrument employed in excavating these wells is a large auger, and the cavity bored is usually from three to four inches in diameter. If a hard rock is met with, it is first triturated by an iron rod, and the materials, being thus reduced to small fragments, or powder, are readily extracted. To hinder the sides of the well from falling in, as also to prevent the spreading of the ascending water in the surrounding soil, a jointed pipe is introduced, formed of wood in Artois, but in other countries more commonly of metal. It frequently happens, that after passing through hundred of feet of retentive soils, a water-bearing stratum is at length pierced, when the fluid immediately ascends to the surface and flows over. The first rush of the water up the tube is often violent, so that for a time the water plays like a fountain, and then, sinking, continues to flow over tranquilly, or sometimes remains stationary at a certain depth below the orifice of the well. This spouting of the water in the first instance is probably owing to the disengagement of air and carbonic acid gas, for both of these have been seen to bubble up with the water.

At Sheerness, at the mouth of the Thames, a well was bored on a low tongue of land near the sea, through 300 feet of the blue clay of London, below which a bed of sand and pebbles was entered, belonging, doubtless, to the plastic clay formation: when this stratum was pierced, the water burst up with impetuosity, and filled the well. By another perforation at the same place, the water was found at the depth of 328 feet, below the surface clay; it first rose rapidly to the height of 189 feet, and then, in the course of a few hours, ascended to an elevation of eight feet above the level of the ground. In 1824, a well was dug at Fulham, near the Thames, at the Bishop of London's, to the depth of 317 feet, which, after traversing the tertiary strata, was continued through 67 feet of chalk. The water immediately rose to the surface, and the discharge was above 50 gallons per minute. In the garden of the Horticultural Society at Chiswick, the borings passed through 19 feet of gravel, 242 of clay and loam, and 67 feet of chalk, and the water then rose to the surface from a depth of 329 feet. At the Duke of Northumberland's above Chiswick, the borings were carried to the extraordinary depth of 620 feet, so as to enter the chalk, when a considerable volume of water was obtained, which rose four feet above the surface of the ground. In a well of Mr. Brooks, at Hammersmith, the rush of water from a depth of 360 feet was so great, as to inundate several buildings and do considerable damage; and at Tooting, a sufficient stream was obtained to turn a wheel, and raise the water to the upper stories of the houses. In the last of three wells bored through the chalk, at Tours, to the depth of several hundred feet, the water rose thirty-two feet above the level of the soil, and the discharge amounted to three hundred cubic yards of water every twenty-four hours.

Excavations have been made in the same way to the depth of eight hundred, and even twelve hundred feet in France, (the latter at Toulouse), and without success. A similar failure was experienced in 1830, in boring at Calcutta, to the depth of more then 150 feet, through the alluvial clay and sand of Bengal. Mr. Briggs, the British consul in Egypt, obtained water between Cairo and Suez, in a calcareous sand, at the depth of thirty feet; but it did not rise in the well. The geological structure of the Sahara is supposed by M. Rozet, to favor the prospect of a supply of water from Artesian wells, as the parched sands on the outskirts of the desert rest on a substratum of argillaceous marl.

Among the causes of the failure of Artesian wells, we may mention those numerous rents and faults which abound in some rocks, and the deep ravines and valleys by which many countries are traversed; for, when these natural lines of drainage exist, there remains a small quantity only of water to escape by artificial issues. We are also liable to be baffled by the great thickness either of porous or impervious strata, or by the dip of the beds, which may carry off the waters from adjoining high lands, to some trough in an opposite direction; as when the borings are made at the foot of an escapement where the strata incline inwards, or in a direction opposite to the face of the cliffs.

The mere distance of hills or mountains need not discourage us from making trials; for the waters which fall on these higher lands readily penetrate to great depths through highly inclined or vertical strata, or through the fissures of shattered rocks, and after flowing for a great distance, must re-ascend, and be brought up again by other fissures, so as to approach the surface in the lower country. Here they may be concealed beneath a covering of undisturbed horizontal beds, which it may be necessary to pierce in order to reach them. It should be remembered, that the course of waters flowing under ground bears but a remote resemblance to that of rivers on the surface, there being in the one case, a constant descent from a higher to a lower level from the source of the stream to the sea; whereas, in the other, the water may at one time sink far below the level of the ocean, and afterwards rise again high above it.

Among other curious facts ascertained by aid of the borer, it is proved, that in strata of different ages and compositions there are often open passages by which the subterranean waters circulate. Thus, at St. Ouen, in France, five distinct sheets of water were intersected in a well, and from each of these a supply obtained. In the third water-bearing stratum, at the depth of 150 feet, a cavity was found in which the borer fell suddenly about a foot, and thence the water ascended in great volume. The same falling of the instrument, as in a hollow space, has been remarked in England and other countries. At Tours, in 1830, a well was perforated quite through the chalk, when the water suddenly brought up from the depth of 364 feet a great quantity of fine sand, with much vegetable matter and shells. Branches of a thorn several inches long, much blackened by their stay in the water, were recognised, as also the stems of marsh plants, and some of their roots which were still white, together with the seeds of the same, in a state of preservation which showed that they had not remained more than three or four months in the water. Among the seeds were those of the march plant *Galium uliginosum*, and among the

shells, a fresh water species (*Planorbis marginatus*) and some land species, as *Helix rotundata* and *H. striata*. M. Dujardin, who, with others, observed this phenomenon, supposes that the waters had flowed from some valleys of Auvergne or the Vivarais since the preceding autumn.

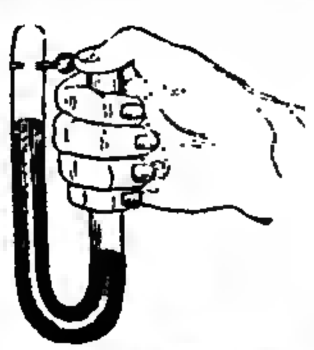
An analogous phenomenon is recorded at Riemke, near Bochum in Westphalia, where the water of an Artesian well brought up, from a depth of 156 feet, several small fish, three or four inches long, the nearest streams in the country being at the distance of some leagues.

In both cases it is evident that water had penetrated to great depths, not simply by filtering through a porous mass, for then it would have left behind the shells, fish, and fragments of plants, but by flowing through some open channels in the earth. Such examples may suggest the idea that the leaky beds of rivers are often the feeders of springs.

(*Continued on page* 394.)

EUDIOMETERS.

To ascertain the exact proportions in which gases combine with each other, and the accurate measurement and chemical properties of their combinations, it is necessary to use one of the instruments called eudiometers, the most effective and convenient of which is that of Dr. Ure. It consists of a glass syphon, with legs nearly of equal length, open and slightly funnel-shaped at one extremity, and hermetically sealed and furnished with platina detonating wires at the other. The sealed leg is graduated by introducing successively equal weights of mercury from a glass measure; 7 oz. and 66 grs. troy occupy the space of a cubic inch, and 34¼ grains represent one-hundredth of that volume. To use this instrument it is filled with mercury, and inverted in the pneumatic trough; a convenient quantity of the gaseous mixture is introduced, and having applied a finger to the orifice, the tube is removed and inverted so as to transfer the gas to the sealed leg, where its quantity is very accurately measured. We then pour a portion of the mercury from the open end of the tube, so as to leave a space of about two inches, and closing the aperture with the thumb, detonate by the electric spark; the included portion of the air acts as a spring, and on withdrawing the thumb, the change of bulk is read off, having previously added mercury, so as to bring it to a level in both legs of the syphon; any liquid or solid that is required may then be passed up into the closed end, for the analysis of the residuary gas.



Note.—In using the eudiometer there ought not to be exploded at the same time a greater volume of gas than a sixth part of the capacity of the detonating vessel, because of the great increase of volume of the gases at the moment of their union; as is evident by the scattering of water, if oxygen and hydrogen are fired under it; the distance to which the cork of the electrical cannon is carried, &c

GILDING.

(*Resumed from page* 367.)

To Gild Leather.—In order to impress gilt figures, letters, and other marks upon leather, as on the covers of books, edgings for doors, &c. the leather must first be dusted over with very finely powdered yellow rosin, or mastic gum. The iron tools or stamps are now arranged on a rack before a clear fire, so as to be well heated, without becoming red hot. If the tools are *letters* they have an alphabetical arrangement on the rack. Each letter or stamp must be tried as to its heat, by imprinting its marks on the raw side of a piece of waste leather. A little practice will enable the workman to judge of the heat. The tool is now to be pressed downwards on the gold leaf; which will of course be indented, and show the figure imprinted on it. The next letter or stamp is now to be taken and stamped in like manner and so on with the others; taking care to keep the letters in an even line with each other, like those in a book. By this operation the resin is melted; consequently the gold adheres to the leather: the superfluous gold may then be rubbed off by a cloth; the gilded impressions remaining on the leather. In this, as in every other operation, adroitness is acquired by practice.

The cloth alluded to should be slightly greasy, to retain the gold wiped off; otherwise there will be a great waste in a few months,) the cloth will thus be soon completely saturated or loaded with the gold. When this is the case, these cloths are generally sold to the refiners, who burn them and recover the gold. Some of these afford so much gold by burning, as to be worth from a guinea to a guinea and a half.

To Gild Writings, Drawings, &c., on Paper or Parchment.—Letters written on vellum or paper are gilded in three ways: in the first, a little size is mixed with the ink, and the letters are written as usual; when they are dry a slight degree of stickiness is produced by breathing on them, upon which the gold leaf is immediately applied, and by a little pressure may be made to adhere with sufficient firmness. In the second method, some white lead or chalk is ground up with strong size, and the letters are made with this by means of a brush: when the mixture is almost dry, the gold leaf may be laid on, and afterwards burnished. The last method is to mix up some gold powder with size, and to form the letters of this by means of a brush. It is supposed that this latter method was that used by the monks in illuminating their missals, psalters, and rubrics.

To Gild the Edges of Paper.—The edges of the leaves of books and letter paper are gilded whilst in a horizontal position in the book-binder's press, by first applying a composition formed of four parts of Armenian bole, and one of candied sugar, ground together with water to a proper consistence, and laid on by a brush with the white of an egg. This coating, when nearly dry, is smoothed by the burnisher; which is generally a crooked piece of agate, very smooth, and fixed in a handle. It is then slightly moistened by a sponge dipped in clean water, and squeezed in the hand. The gold leaf is now taken up on a piece of cotton, from the leathern cushion, and applied on the

moistened surface. When dry, it is to be burnished by rubbing the agate over it repeatedly from end to end, taking care not to wound the surface by the point of the burnisher. A piece of silk or India paper is usually interposed between the gold and the burnisher.

Cotton wool is generally used by book-binders to take the leaf up from the cushion; being the best adapted for the purpose on acount of its pliability, smoothness, softness, and slight moistness.

Oil Gilding on Wood.—The wood must first be covered, or primed, by two or three coatings of boiled linseed oil and carbonate of lead, in order to fill up the pores, and conceal the irregularities of the surface, occasioned by the veins in the wood. When the priming is quite dry, a thin coat of gold-size must be laid on. This is prepared by grinding together some red oxide of lead with the thickest drying oil that can be procured, and the older the better, that it may work freely: it is to be mixed, previously to being used, with a little oil of turpentine, till it is brought to a proper consistence. If the gold-size is good, it will be sufficiently dry in two hours, more or less, to allow the artist to proceed to the last part of the process, which is leaf of gold is spread on a cushion (formed by few folds of flannel secured on a piece of wood, about eight inches square, by a tight covering of leather), and is cut into strips of a proper size by a blunt pallet knife; each strip being then taken upon the point of a fine brush, is applied to the part intended to be gilded, and is then gently pressed down by a ball of soft cotton; the gold immediately adheres to the sticky surface of the size, and after a few minutes, the dexterous application of a large camel's hair brush sweeps away the loose particles of the gold leaf without disturbing the rest. In a day or two the size will be completely dried, and the operation will be finished.

The advantages of this method of gilding are, that it is very simple, very durable, and not readily injured by changes of weather, even when exposed to the open air; and when soiled it may be cleaned by a little warm water and a soft brush; its chief employment is in out-door work. Its disadvantage is, that it cannot be burnished, and therefore wants the high lustre produced by the following method.

To Gild by Burnishing.—This operation is chiefly performed on picture frames, mouldings, beadings, and fine stucco work. The surface to be gilt must be carefully covered with a strong size, made by boiling down pieces of white leather, or clippings of parchment, till they are reduced to a stiff jelly; this coating being dried, two or three more must be applied, consisting of the same size, mixed with fine Paris plaster or washed chalk; when a sufficient number of layers have been put on, varying according to the nature of the work, tha application of the gold. For this purpose, a and the whole is become quite dry, a moderately thick layer must be applied, composed of size and Armanian bole, or yellow oxide of lead; while this last is yet moist, the gold leaf is to be put on in tha usual manner; it will immediately adhere on being pressed by tha cotton ball, and before the siza is becoma perfectly dry, those parta which ara intended to be the most brilliant are to be carefully burnished by an agate or dog's tooth fixed in a handle.

In order to save the labour of burnishing, it is a common, but bad practice, slightly to burnish the brilliant parts, and to deaden the rest by drawing a brush over them dipped in size; the required contrast betwen the polished and the unpolished gold is indeed thus obtained; but the general effect is much inferior to that produced in tha regular way, and the smallest drop of water falling on the sized part occasions a stain. This kind of gilding can only be applied on in-door work; as rain, and even a considerable degree of dampness, will occasion the gold to peel off. When dirty, it may be cleaned by a soft brush, with hot spirits of wine, or oil of turpentine.

To Gild Copper, &c. by Amalgam.—Immerse a very clean bright piece of copper in a diluted solution of nitrate of mercury. By the affinity of copper for nitric acid, the mercury will be precipitated; now spread the amalgam of gold rather thinly over the coat of mercury just given to the copper. This coat unites with the amalgam, but of course will remain on the copper. Now place the piece or pieces so operated on in a clean oven or furnace, where there is no smoke. If the heat is a little greater than 66 degrees, the mercury of the amalgam will be volatilised, and the copper will be beautifully gilt.

In the large way of gilding, the furnaces are so contrived that the volatilised mercury is again condensed, and preserved for further use, so that there is no loss in the operation. There is also a contrivance by which the volatile particles of mercury are prevented from injuring the gilders.

To Gild Steel.—Pour some of the ethereal solution of gold into a wine glass, and dip therein the blade of a new pen-knife, lancet, or razor; withdraw the instrument, and allow the ether to evaporate. The blade will be found to be covered by a very beautiful coat of gold. A clean rag, or small piece of very dry sponge, may be dipped in the ether, and used to moisten the blade, with the same result.

In this case there is no occasion to pour tha liquid into a glass, which must undoubtedly lose by evaporation; but the rag or sponge may be moistened by it, by applying either to the mouth of the phial. This coating of gold will remain on tha steel for a great length of time, and will preserva it from rusting.

This is the way in which swords and other cutlery are ornamented. Lancets too are in this way gilded with great advantage, to secure them from rust.

To heighten the color of Yellow Gold.—

6 oz. saltpetre.
2 oz. copperas.
1 oz. white vitriol. and
1 oz. alum.

If it be wanted redder, a small portion of blue vitriol must be added. These are to be well mixed, and dissolved in water as the color is wanted.

To heighten the color of Green Gold.

1 oz. 10 dwts. saltpetre.
1 oz. 4dwts. sal ammoniac.
1 oz. 4 dwts. Roman vitriol, and
18 dwts. verdigris.

Mix them well together, and dissolve a portion in water, as occasion requires.

The work must be dipped in these compositions, applied to a proper heat to burn them off, and then quenched in water or vinegar.

To heighten the color of Red Gold.—

To 4 oz. melted yellow wax, add
1½ oz. red ochre in fine powder,
1½ oz. verdigris, calcined till it yield no fumes, and
¼ oz. calcined borax.

It is necessary to calcine the verdigris, or else, by the heat applied in burning the wax, the vinegar becomes so concentrated as to corrode the surfaces, and make it appear speckled.

To separate Gold from Gilt Copper and Silver.—Apply a solution of borax, in water, to the gilt surface, with a fine brush, and sprinkle over it some fine powdered sulphur. Make the piece red hot, and quench it in water. The gold may be easily wiped off with a scratch brush, and recovered by testing it with lead.

Gold is taken from the surface of silver by spreading over it a paste, made of powdered sal ammoniac, with aqua fortis, and heating it till the matter smokes, and is nearly dry; when the gold may be separated by rubbing it with a scratch brush.

CLIMATE OF LONDON.

It is a circumstance not, perhaps, generally known, that the temperature of the air in the metropolis is raised by the artificial sources of heat existing in it, no less than two degrees on the annual mean above that of its immediate vicinity. Mr. Howard, in his work on "Climate," has fully established this fact, by a comparison of a long series of observations, made at Plaistow, Stratford, and Tottenham Green, (all within five miles of London,) with those made at the apartments of the Royal Society in London, and periodically recorded in the "Philosophical Transactions." His explanation of the causes of this difference is simple and convincing. "Whoever," he says, "has passed his hand over the surface of a glass hive, whether in summer or winter, will have perceived how much the bodies of the collected multitude of bees are capable of heating the place that contains them. But the proportion of heat, which is induced in a city by the population, must be far less considerable than that emanation from fires, the greater part of which are kept up for the very purpose of preventing the sensation attending the escape of heat from our bodies, a temperature equal to that of spring is hence maintained in the depth of winter, in the included part of the atmosphere, which as it escapes from the houses is constantly renewed; another and more considerable portion of heated air is constantly poured into the common mass from the chimnies—to which, lastly, we have to add the heat diffused in all directions from the foundries, breweries, steam engines, and other manufactories, and culinary fires. When we consider that all these artificial sources of heat, with the exception of the domestic fires, continue in full operation throughout the summer, it should seem, that the excess of the London temperature must be still greater in June than it is in January, but the fact is otherwise. The excess of the city temperature is greater in winter, and at that period seems to belong entirely to the night, which average 3·710 degrees warmer than the country, while the heat of the days, owing, without doubt, to the interception of a portion of the solar rays, by a constant veil of smoke, falls, on a mean of years, about a third of a degree short of that in the open plains."

STEEL.

Steel is a compound of iron and carbon. The furnace in which iron is converted into steel, has the form of a large oven, or arch, terminating in a vent at the top. The floor of this oven is flat and level. Immediately under it there is a large arched fire-place, with grates, which runs quite across from one side to the other, so as to have two doors for putting in the fuel from the outside of the building. A number of vents, or flues, pass from the fire-place, to different parts of the floor of the oven, and throw up their flame into it, so as to heat all parts of it equally. In the oven itself, there are two large and long cases or boxes, built of good fire stone; and in these boxes the bars of iron are regularly stratified with charcoal powder, ten or twelve tons of iron being put in at once, and the box is covered on the top with a bed of sand. The heat is kept up, so that the boxes and all their contents are red hot for eight or ten days. A bar is then drawn out and examined; and if it be found then sufficiently converted into steel, the fire is withdrawn and the oven allowed to cool. This process is called *cementation*. The bars of steel formed in this way are raised, in many parts, into small blisters, obviously by a gas evolved in the interior of the bar, which had pushed up, by its elasticity, a film of the metal. On this account the steel made by this process is usually called *blistered steel*. The bars of blistered steel are heated to redness, and drawn out into smaller bars by means of a hammer, driven by water or steam, and striking with great rapidity. This hammer is called a *tilting hammer*, on which account, the small bars formed by it are called *tilted steel*. When the bars are broken in pieces and welded repeatedly, and then drawn out into bars, they acquire the name of *German* or *shear steel*. Steel of cementation, however carefully made, is never quite equable in its texture; but it is rendered quite so by fusing it in a crucible, and then casting it into bars. Thus treated it is called *cast steel*. When steel is to be cast, it is made by cementation in the usual way, only the process is carried somewhat farther, so as to give the steel a whiter color. It is then broken into small pieces, and put into a crucible of excellent fire clay, after which the mouth of the crucible is filled up with vitrefiable sand, to prevent the steel from being oxidized by the action of the air. The crucible is exposed for five or six hours to the most intense heat that can be raised, by which the steel is brought into a state of perfect fusion. It is then cast into parallelopipeds about a foot and a half in length. To fuse one ton of steel, about twenty tons of coals are expended, which accounts for the high price of cast steel, when compared with that of iron, or even of common steel. Every time that cast steel is melted, it loses some of its characteristic properties; and two or three fusions render it quite useless for the purposes for which it is intended. It has recently been proved that the steel of which the Damascus blades were made, and which was steel from Golconda, owed the peculiarity which these blades have of showing a curious waving texture on the surface, when treated with a dilute acid, to their consisting of two different compounds of iron and carbon, which have separated during cooling. It is cast steel in which the process is carried farther than usual and which is cooled slowly; both common steel and cast steel are formed, which separate during the slow cooling. The steel is rendered black by the acid, while the cast iron remains white. This kind of steel can only be hammered at a heat above that of cherry-red.

The specific gravity of good blistered steel is 7·823. When this steel is heated to redness, and suddenly plunged into cold water, its specific gravity is reduced to 7·747. The specific gravity of a piece of cast steel, while soft, is 7·82; but when hardened by heating red hot, and plunging it into cold water, it is reduced to 7·7532. Hence it appears, that when steel is hardened, its bulk increases. The color of steel is whiter than that of iron. Its texture is granular, and not hackly, like that of iron. The fracture is whitish grey, and much smoother than the fracture of iron. It is much harder and more rigid than iron; nor can it be so much softened by heat without losing its tenacity and flying in pieces under the hammer. It requires more attention to forge it well, than to forge iron; yet it is by its toughness and capability of being drawn out in bars, that good steel is distinguished from bad. Steel is more readily broken by bending it than iron. If it be heated to redness, and then plunged into cold water, it becomes exceedingly hard, so as to be able to cut or make an impression upon most other bodies. But, when iron is treated in the same way, its hardness is not in the least increased. When a drop of nitric acid is let fall upon a smooth surface of steel, and allowed to remain on it for a few minutes, and then washed off with water, it leaves a black spot; whereas the spot left by nitric acid on iron, is whitish green. Dr. Thompson gives the following as the composition of cast steel:—

Iron	99
Carbon, with some silicon .	1
	100

The *natural steel* or *German steel*, is an impure and variable kind of steel, procured from cast iron, or obtained at once from the ore. It has the property of being easily welded, either to iron or to itself. Its grain is unequally granular, sometimes even fibrous; its color is usually blue; it is easily forged; it is requires a strong heat to temper it, and it then acquires only a middling hardness. When forged repeatedly, it does not pass into iron so easily as the other kinds. The natural steel yielded by cast iron, manufactured in the refining houses, is known by the general name of *furnace steel;* and that which has only been once treated with a refining furnace, is particularly called *rough steel*, and is frequently very unequally converted into steel. The best cast iron for the purpose of making natural steel, is that obtained from the brown hæmatite, or from the sparry iron ore. White cast iron does not yield steel, unless its charge of carbon is increased, either by stirring the melted metal with a long pole, and keeping it melted a long time, that it may absorb charcoal from the lining of the furnace, or by melting it with dark colored iron. Black cast iron yields a bad, brittle steel, unless the excess of carbon that it contains is either burnt away, or it is mixed with finery cinder. The cast iron to be converted into steel is then melted in blast furnaces, and treated nearly the same as if it were to be refined into iron bar, only the blast is weaker; the bellows instead of being directed so as to throw the wind upon the surface of the melted metal, is placed nearly horizontally; the melted metal is kept covered with slag, and is not disturbed by stirring. When the iron is judged to be sufficiently refined, and is grown solid, it is withdrawn from the furnace and forged. The natural steel made directly from the above mentioned ores, in small blast furnaces, is a good steel for ploughs and similar machines; the best of it is excellent for saws and cutlery. The most esteemed steel of this kind comes from Germany, and is made in Stiria. It is usually sold in chests or barrels, two and a half or three feet long.

ENAMELLING.

The art of enamelling consists in the application of a smooth coating of vitrified matter to a bright polished metallic surface. It is, therefore, a kind of varnish made of glass, and melted upon the substance to which it is applied, affording a fine uniform ground for an infinite variety of ornaments, which are also fixed on by heat.

The general principles on which enamelling is founded, are, on the whole, very simple; but perhaps, there is none of all the chemico-mechanical arts which requires, for the finer parts, a greater degree of practical skill and dexterity, and of patient and accurate attention to minute processes. The concealment observed by those who profess this art, is proportioned to the difficulty of acquiring it; the chemist must, therefore, content himself with the general principles of enamelling, and with the detail of those particulars that are commonly known.

Though the term enamelling is usually confined to the ornamental glazing of metallic surfaces, it strictly applies to the glazing of pottery or porcelain, the difference being only, that in the latter, the surface is of baked clay. With regard to the composition of colored enamels, (which are all tinged by different metallic oxides,) a very general account of the substances used will suffice.

The only metals that are enamelled are gold and copper; and with the latter the opaque enamels, only, are used. Where the enamel is transparent and colored, the metal chosen should not only have its surface unalterable, when fully red-hot, but also be in no degree chemically altered by the close contact of melted glass, containing an abundance of some kind of metallic oxide. This is the chief reason why colored enamelling on silver is impracticable, though the brilliance of its surface is not impaired by mere heat; for if an enamel made yellow with oxide of lead, or antimony, be laid on the surface of bright silver, and be kept melted on it for a certain time, the silver and the enamel act on each other so powerfully, that the color soon changes from a yellow to an orange, and lastly to a dirty olive. Copper is equally altered by the colored enamels, so that gold is the only metal which can bear the long contact of the colored glasses at a full red heat, without being altered by them.

Enamel for Dial Plates.—The simplest kind of enamel is that fine white opaque glass, which is applied to the dial plates of watches. The process of laying on which is as follows:—A piece of thin sheet copper, hammered to the requisite convexity, is first accurately cut out, a hole drilled in the middle for the axis of the hands, and both the surfaces made perfectly bright with a brush.

A small rim is then made round the circumference, with a thin brass band rising a little above the level, and a similar rim round the margin of the central hole. The use of these is to confine the enamel when in fusion, and to keep the edges of the plate quite neat and even. The substance of the enamel

is a fine white opaque glass; this is bought in lump by the enamellers, and is first broken down with a hammer, then ground to a powder sufficiently fine, with some water, in an agate mortar; the superfluous water being then poured off, the pulverized enamel remains of about the consistence of wetted sand, and is spread very evenly over the surface of the copper-plate. In most enamellings, and especially on this, it is necessary also to counter-enamel the under concave surface of the copper-plate, to prevent its being drawn out of its true shape, by the unequal shrinking of the metal, and enamel, on cooling. For this kind of work, the counter-enamel is only about the half the thickness on the concave, as on the convex side. For flat plates, the thickness is the same on both sides.

The plate, covered with the moist enamel powder, is warmed and thoroughly dried, then gently set upon a thin earthen ring, that supports it only by touching the outer rim, and put gradually into the red hot muffle of the enameller's furnace. This furnace is constructed somewhat like the assay furnace, but the upper part alone of the muffle is much heated, and some peculiarities are observed in the construction, to enable the artist to govern the fire more accurately.

The precise degree of heat to be given here, as in all enamelling, is that at which the particles of the enamel run together into an uniform pasty consistence, and extend themselves evenly, showing a fine polished face; carefully avoiding, on the other hand, so great a heat as would endanger the melting of the thin metallic plate. When the enamel is thus seen to *sweat down*, as it were, to an uniform glossy glazing, the piece is gradually withdrawn and cooled.

Second Coating with Division Marks.—A second coating of enamel is then laid on, and fired as before; but this time, the finest powder of enamel is taken, or that which remains suspended in the washings. It is then ready to receive the figures and division marks, which are made of a black enamel, ground in an agate mortar, to a most impalpable powder, worked up, on a pallet, with oil of lavender, and laid on with an extremely fine hair brush. The plate is then stoved to evaporate the essential oil, and the figure is burnt in, as before. Polishing with tripoli, and minuter parts of the process, need not be here described.

If the enamel be chipped off a dial plate, (which may be done with the utmost ease, by bending it backwards and forwards, as the adhesion between the metal and enamel are slight.) the part immediately in contact with the copper, will be found deeply and nearly uniformly browned, which shows how unfit copper alone would be for the transparent enamels.

The regulation of the fire appears to be the most difficult of all the parts of this nice process, particularly in the fine enamelling of gold for ornamental purposes, for designs, miniatures, and the like; where three, four, or sometimes five separate firings are required. If the heat is too low, the enamel does not spread and vitrify as it ought; if too high, it may be enough to melt the metal itself, whose fusing point is but a small step above that of the enamel; or else, (what is an equal mortification to the artist,) the delicate figures laid on with so much care and judgement, melt down in a moment; and the piece exhibits only a confused assemblage of lines, and fragments of designs.

(*Continued on page* 397.)

MISCELLANIES.

Shining German Blacking.—Break in pieces a cake of white wax, and put it in a tin tube, or any earthen vessel; pour over it as much oil of turpentine as will quite cover it, and for twenty-four hours, let it be closely covered up. In this time, the wax will be found dissolved to a paste, which is then to be mixed with as much real ivory black, in fine powder, as is necessary to give the entire composition a very black color. When it is wanted for use, take a little of it out, on the point of a knife, and rub it into the leather of the boots, shoes, &c., with a brush, which will cause the ethereal spirit of the oil to evaporate, leaving the wax on the surface of the leather, quite firm, black, and glossy. Should the composition get dry, stir in a little fresh oil of turpentine.

Excellent Blacking.—Ivory black, ground fine, 4 ounces; treacle, 2 ounces; vinegar, ½ of a pint; spermaceti oil, a tea-spoonful. If the ingredients are of the best qualities, this blacking will be found exceedingly good. Mix the oil with the black first, then add the treacle, and lastly the vinegar.

To remove a Hard Coating or Crust from Glass and Porcelain Vessels.—It often happens that glass vessels, used as pots for flowers and other purposes, receive an unsightly deposit or crust, hard to be removed by scouring or rubbing.—The best method to take it off, is to wash it with a little dilute muriatic acid. This acts upon it and loosens it very speedily.—*Journal des Connaissances Usuelles.*

German Razor-stone.—This is universally known throughout Europe, and generally esteemed as the best whet-stone for all kinds of the finer description of cutlery. It is obtained from the slate mountains in the neighbourhood of Ratisbon, where it occurs in the form of a yellow vein running virtually into the blue slate, sometimes not more than an inch in thickness, and varying to twelve and sometimes eighteen inches, from whence it is quarried, and then sawed into thin slabs, which are usually cemented into a similar slab of the slate, to serve as a support, and in that state sold for use. That which is obtained from the lowest part of the vein is esteemed the best, and termed old rock.—Mr. R. Knight, in *Trans. Society of Arts.*

Substitute for India Ink.—Boil in water, some parchment or pieces of fine gloves, until it is reduced to a paste. Apply to its surface while still warm, a porcelain dish which has been held over a smoking lamp: the lamp black which adheres to it, will become detached and mingle with the paste or glue.—Repeat the operation until the composition has acquired the requisite color. It is not necessary to grind it. It flows as freely from the pencil as India ink, and has the same transparency.

QUERIES.

175—What is there in the juice of the lemon, &c., which, used as sympathetic ink, causes it to appear dark when scorched by fire?

176—Can ventriloquism be acquired? and, if so, how? *Answered on page* 396.

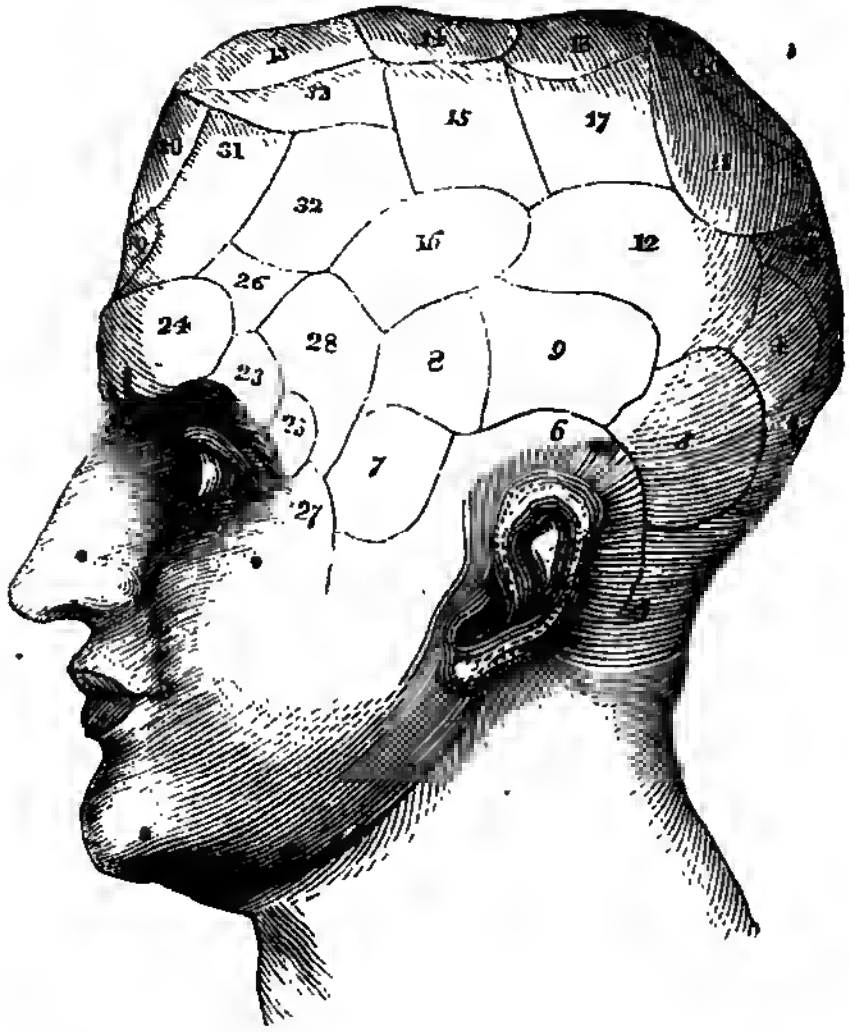
177—How is paper embossed? *Answered on page* 414.

178—What is the ground nut, and how can oil be extracted from it? *Answered on page* 414

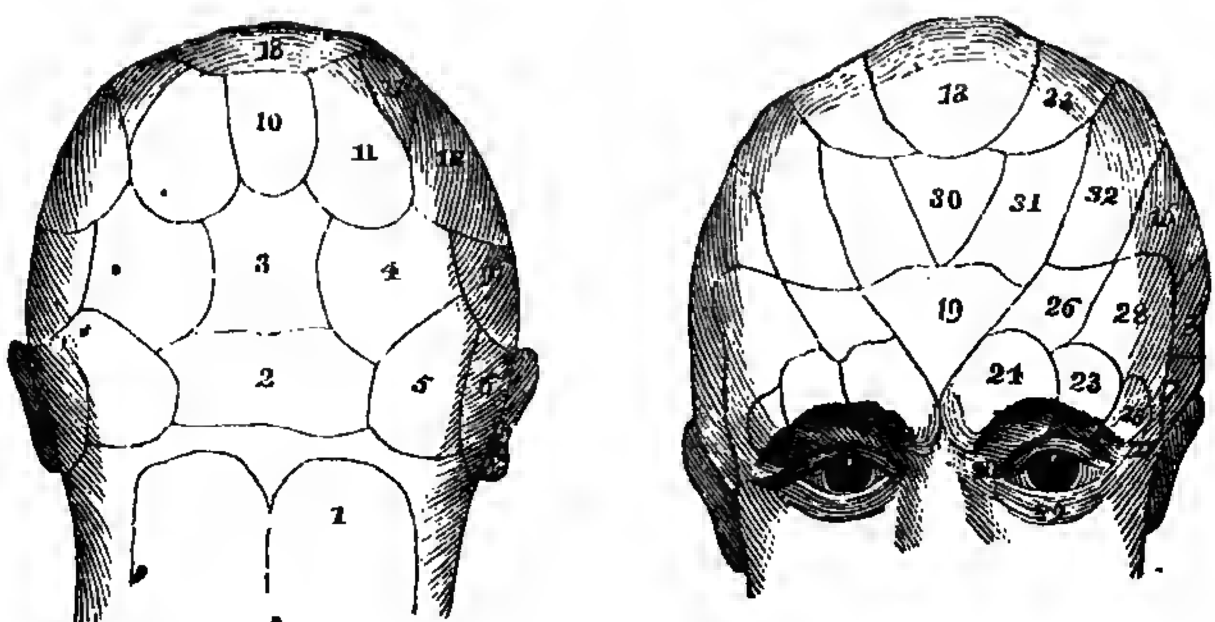
179—How is black lead prepared for pencils? *Answered on page* 414.

180—What is the cause of ignition, of heat, and of radiation of heat?

181—How does nitrate of soda act when used as a manure, and what quantity per acre is most beneficial? *Answered on page* 414


33
15
17
31
32
16
12
26
24
28
8
9
23
6
7
27

PHRENOLOGY.


18
10
11
3
4
2
5
1
13
30
31
32
19
26
24
23

PHRENOLOGY.

We have some hesitation in admitting papers on this subject, believing it scarcely to come within our province. A single paper, or two, however, upon its more general principles, and the situation of the various organs, may not be wholly without their use, as conveying a general idea of the matter; and enabling our country subscribers, who may never have studied Phrenology, to form a slight acquaintance with the opinions of its advocates. In doing so, however, we wish it to be understood, that we give no opinion of our own. In fact, the enumeration of the various organs, which our present cuts display, and the latter part of this account explains the use of, are, for the most part, copied from a work by George Combe, entitled "The Constitution of Man."

The system of Phrenology is concisely this:—Man is known to have a body, the object of our senses; and a mind of which we know nothing but by its effects. This mind is endowed with an undetermined number of propensities, sentiments, and faculties—each of which has appropriated to its service a limited portion of the brain, by which it acts, and which is therefore called its *organ*; the surface of the brain is unequal in proportion to the greater or less developement of these organs; the skull covers the brain, in most cases as closely as one coat of an onion covers another, consequently the same inequalities must be apparent on the *outside* of the cranium as exist on the external surface of the brain; and, lastly, by a proper attention to those elevations, protuberances, embossments, bumps, knobs, or excrescences, as they have been differently denominated, we may soon become as familiar with the mind as we are with the body.

According to Phrenology the human faculties are the following:—the organs are double, each faculty having two, lying in corresponding situations of the hemispheres of the brain. The numbers appended to each organ correspond to the numbers on the illustrative cuts.

Order 1. FEELINGS.

Genus 1. PROPENSITIES—*Common to Man with the Lower Animals.*

The Love of Life.

Appetite for Food.—*Uses.* Nutrition.—*Abuses:* Gluttony and drunkenness.

1. Amativeness.—Produces sexual love.
2. Philoprogenitiveness.—*Uses:* Affection for young and tender beings.—*Abuses:* Pampering and spoiling children.
3. Concentrativeness.—*Uses:* It gives the desire of permanence in place, and renders permanent emotions and ideas in the mind.—*Abuses:* Aversion to move abroad; morbid dwelling on internal emotions and ideas, to the neglect of external impressions.
4. Adhesiveness.—*Uses:* Attachment; friendship and society result from it.—*Abuses:* Clanship for improper objects, attachment to worthless individuals. It is generally strong in women.
5. Combativeness.—*Uses:* Courage to meet danger and overcome difficulties, tendency to oppose and attack whatever requires opposition, and to resist unjust encroachments.—*Abuses:* Love of contention, and tendency to provoke and assault. This feeling obviously adapts man to a world in which danger and difficulty abound.
6. Destructiveness.—*Uses:* Desire to destroy noxious objects, and to kill for food. It is very discernable in carnivorous animals.—*Abuses:* Cruelty, murder, desire to torment, tendency to passion, rage, and harshness and severity in speech and writing. This feeling places man in harmony with death and destruction, which are woven into the system of sublunary creation.
7. Secretiveness.—*Uses:* Tendency to restrain within the mind the various emotions and ideas that involuntarily present themselves, until the judgment has approved of giving them utterance; it is simply the propensity to conceal, and is an ingredient in prudence.—*Abuses:* Cunning, deceit, duplicity, and lying.
8. Acquisitiveness.—*Uses:* Desire to possess, and tendency to accumulate articles of utility, to provide against want.—*Abuses:* Inordinate desire of property, selfishness, avarice, theft.
9. Constructiveness.—*Uses:* Desire to build and construct works of art.—*Abuses:* Construction of engines to injure or destroy, and fabrication of objects to deceive mankind.

Genus II. SENTIMENTS.

I. *Sentiments common to Man with the Lower Animals.*

10. Self-Esteem.—*Uses:* Self-respect, self-interest, love of independence, personal dignity.—*Abuses:* Pride, disdain, overweening conceit, excessive selfishness, love of dominion.
11. Love of Approbation.—*Uses:* Desire of the esteem of others, love of praise, desire of fame or glory.—*Abuses:* Vanity, ambition, thirst for praise independently of praise-worthiness.
12. Cautiousness.—*Uses:* It gives origin to the sentiment of fear, the desire to shun danger, and circumspection; and it is an ingredient in prudence.—*Abuses:* Excessive timidity, poltroonery, unfounded apprehensions, despondency, melancholy.
13. Benevolence.—*Uses:* Desire of happiness o. others, universal charity, mildness of disposition, and a lively sympathy with the enjoyment of all animated beings.—*Abuses:* Profusion, injurious indulgence of the appetites and fancies of others, prodigality, facility of temper.

II. *Sentiments proper to Man.*

14. Veneration.—*Uses:* Tendency to venerate or respect whatever is great and good; gives origin to religious adoration.—*Abuses:* Senseless respect for unworthy objects consecrated by time or situation, love of antiquated customs, abject subserviency to persons in authority, superstitious awe.
15. Firmness.—*Uses:* Determination, preseverance, steadiness of purpose.—*Abuses:* Stubbornness, infatuation, tenacity in evil.
16. Conscientiousness.—*Uses:* It gives origin to the sentiment of justice, or respect for the rights of others, openness to conviction, the love of truth.—*Abuses:* Scrupulous adherence to noxious principles when ignorantly embraced, excessive refinement in the views of duty and obligation, excess in remorse or self-condemnation.
17. Hope.—*Uses:* Tendency to expect future good; it cherishes faith.—*Abuses:* Credulity with respect to the attainment of what is desired, absurd expectations of felicity not founded on

18. Wonder.—*Uses:* The desire of novelty; admiration of the new, the unexpected, the grand, the wonderful, and extraordinary.—*Abuses:* Love of the marvellous and occult; senseless astonishment; belief in false miracles, in prodigies, magic, ghosts, and other supernatural absurdities.—*Note.* Veneration, Hope, and Wonder, combined, give the tendency to religion; their abuses produce superstition.
19. Ideality.—*Uses:* Love of the beautiful and splendid, desire of excellence, poetic feeling.—*Abuses:* Extravagance and absurd enthusiasm, preference of the showy and glaring to the solid and useful, a tendency to dwell in the regions of fancy, and to neglect the duties of life.
20. Wit—Gives the feeling of the Iudicrous, and disposes to mirth.
21. Imitation—Copies the manners, gestures, and actions of others, and appearances in nature generally.

Order II. INTELLECTUAL FACULTIES.

Genus I. EXTERNAL SENSES.

Feeling, or Touch Taste Smell Hearing Sight	*Uses:* To bring man into communication with external objects, and to enable him to enjoy them.—*Abuses:* Excessive indulgences in the pleasures arising from the senses, to the extent of impairing bodily health, and debilitating or deteriorating the mind.

Genus II. KNOWING FACULTIES, WHICH PERCEIVE THE EXISTENCE AND QUALITIES OF EXTERNAL OBJECTS.

22. Individuality—Takes cognizance of existence and simple facts.
23. Form—Renders man observant of form.
24. Size—Gives the idea of space, and enables us to appreciate dimension and distance.
25. Weight—Communicates the perception of momentum, weight, and resistance; and aids equilibrium.
26. Coloring—Gives perception of colors and their harmonies.

Genus III. KNOWING FACULTIES, WHICH PERCEIVE THE RELATIONS OF EXTERNAL OBJECTS.

27. Locality—Gives the idea of relative position.
28. Number—Gives the talent for calculation.
29. Order—Communicates the love of physical arrangement.
30. Eventuality—Takes cognizance of occurrences or events.
31. Time—Gives rise to the perception of duration.
32. Tune—The sense of Melody and Harmony arises from it.
33. Language—Gives facility in acquiring a knowledge of arbitrary signs to express thoughts, readiness in the use of them, and the power of inventing and recollecting them.

Genus IV. REFLECTING FACULTIES, WHICH COMPARE, JUDGE, AND DISCRIMINATE.

34. Comparison—Gives the power of discovering analogies, resemblances, and differences.
35. Causality—Traces the dependencies of phenomena, and the relation of cause and effect.

BROMINE.

This singular substance, first described in the *Annales de Chim. et Physique*, for August, 1826, was discovered by M. Balard, of Montpelier. Bromine is usually obtained from the uncrystallizable residue of sea-water, commonly called *bittern;* a current of chlorine is passed through this liquid, which immediately gives it an orange tint, in consequence of the evolution of bromine from its combinations; a portion of sulphuric ether is then shaken up with it, which, as it separates upon the surface, is found to have abstracted the bromine, and acquired a reddish-brown tint. The ethereal solution is agitated with solution of potassa, by which bromate of potassa and bromide of potassium are formed, and the whole being evaporated to dryness, and exposed to a dull-red heat, leaves *bromide of potassium.* The solution of this salt is decomposed by passing chlorine into it, or by mixing it with a strong solution of chlorine; chloride of potassium is formed, and the bromine, being volatile, may be separated by distillation, and condensed in a receiver cooled by ice.

Bromine probably exists in sea-water in the state of hydrobromate of magnesia, but its relative proportion must be exceedingly minute. One hundred pounds of sea-weed taken up at Trieste, afforded, by M. Balard's process, 5 grains of bromide of sodium = 3·3 grains of bromine. It would appear, that in the sea-water at Trieste, the bromine is unaccompanied by any iodine; and the same is the case, according to M. Hermbstadt, with the waters of the Dead Sea. In the water of the Mediterranean, on the contrary, iodine is always found with bromine. It is most readily recognized by evaporating the water, so as to separate all its more ordinary uncrystallizable contents, reducing the remainder to a very small bulk, and dropping in a concentrated solution of chlorine. In the absence of iodine, which may be detected by starch, the appearance of a yellow tint announces bromine. It has thus been discovered, not only in the waters of the ocean, but in certain salt springs, in the ashes of marine plants, and in those of some marine animals.

At common temperatures and pressures bromine is a deep reddish brown liquid, of a peculiarly suffocating and disagreeable odour, whence its name (from βρῶμος, *graveolentia.*) Its specific gravity is about 3. It emits a brownish red vapour at common temperatures, and boils rapidly at 116 degrees. At a temperature somewhat below 0 degrees it congeals into a brittle solid. It is a non-conductor of electricity, and appears in the voltaic circuit at the positive pole. It suffers no change by transmission through red-hot tubes, and cannot, by any known process, be resolved into simpler forms of matter. It dissolves sparingly in water, and forms under certain circumstances a definite *hydrate,* which, according to Lowig, (Poggendorf's *Annalen* xiv. 114,) is obtained by exposing bromine with a small quantity of water to a temperature of 32 degrees; red octoedral crystals of the *hydrate of bromine* are then deposited, which continue permanent at the temperature of 50 degrees. At a higher temperature they decompose into a liquid bromine and aqueous solution of it. The hydrate is also obtained by passing the vapour of bromine through a moistened tube cooled nearly to the freezing point. Bromine dissolves in alcohol; and more abundantly in ether. It destroys vegetable colors. When a burning taper is immersed into its vapour it is speedily

extinguished, the flame previously assuming a green and red tint. Phosphorus spontaneously inflames in its vapour; tin and antimony also burn in it; and it combines with potassium with explosive violence. Its action on alkaline solutions will be found analagous to that of chloride and iodine. It stains the skin of a yellow color; acts with energy upon most vegetable and animal substances and is fatal to animal life; a single drop placed upon the beak of a bird immediately killed it. The specific gravity of its vapour has not been correctly determined, but its equivalent number appears, from Berzelius's analysis of bromide of silver, to be about 78, which ought also to express its specific gravity in vapour compared with hydrogen. The density of its vapour compared to air, will, therefore, be about 5.4, and 100 cubical inches should weigh about 168 grains. The alcoholic solution of bromine, and the bromide of sodium are occasionally used in medicine; and from its powerful action there can be no doubt that it must contribute to the medicinal virtues of the mineral waters in which it exists.

Bromine and Oxygen.—Bromic Acid. One compound only of bromine and oxygen has as yet been discovered, namely, the *bromic acid*. Bromic acid is obtained by the decomposition of a solution of *bromate of baryta* by sulphuric acid: sulphate of baryta is precipitated, and a solution of bromic acid is obtained, which may be concentrated by slow evaporation; at a high temperature it is partly decomposed, so that it cannot be obtained anhydrous. It is sour, inodorous, and first reddens, and then destroys the blue of litmus. It is partially decomposed by concentrated sulphuric acid, but not by nitric acid. It is decomposed by sulphuric acid, by sulphuretted hydrogen, and by hydriodic and hydrochloric acids. From the analysis of bromate of potassa there can be no doubt that the bromic acid is analogous in composition with chloric and iodic acids, and that it consists of

Bromine	..	1	..	78	..	66.1
Oxygen	..	5	..	40	..	33.9

Chloride of Bromine.—By passing chlorine through bromine, and condensing the vapours at a low temperature, a reddish yellow fluid is obtained, having a penetrating odour and disagreeable taste. It is very fluid and volatile, emitting yellow vapours; it dissolves in water, and the solution destroys vegetable colors: it would appear, therefore, not to decompose water. Chlorine decomposes most of the compounds of bromine, and hence is useful as a test of its presence. When dropped, for instance, into a weak solution of bromide of potassium, or of sodium, the evolution of bromine is manifested by the deep yellow color that is produced, and by the odour of the vapour of bromine.

Iodide of Bromine.—Iodine and bromine probably combine in two proportions, but the compounds have not been analyzed. In certain proportions, probably one proportional of iodine and one of bromine, a solid body is obtained, which yields reddish brown vapours when heated, and these readily condense into arborescent crystals. A further addition of bromine dissolves these, forming a dark-colored liquid, soluble in water possessed of bleaching qualities, and yielding bromides and iodides with the alkalies.

MAKING PRINTERS' ROLLERS.

To eight pounds of transparent glue, add as much rain or river water as will just cover it; and occasionally stir it during seven or eight hours. After standing for twenty-four hours, and all the water is absorbed, submit it to the action of heat, in a water bath, (that is, surrounded by water, as glue is generally heated), and the glue will soon be dissolved. Remove it from the fire as soon as froth is seen to rise; and mix with it seven pounds of molasses, which has been previously made tolerably hot: stir the composition well together, in the water-bath, over the fire, but without suffering it to boil. After being thus exposed to the heat for half an hour, and frequently well stirred, it should be withdrawn from over the fire, and allowed to cool for a short time, previous to pouring it into a cylindrical mould, made of tin, tinned sheet-iron, or copper, having a wooden cylinder previously supported in its centre, by means of its end-pivots or gudgeons.

After remaining in the mould at least eight or ten hours in winter, and a longer time in summer, the roller is to be taken out of the mould, by means of a cord fastened to one of the gudgeons, and passed over a strong pulley fixed to the ceiling; but care must always be taken that the cylinder is drawn out slowly from the mould.

Old rollers are re-cast in the same manner; first taking care to wash them with a strong alkaline ley, and adding a small quantity of water and molasses. The best mode, however, of making use of the old composition, is, by mixing it with some new, made of two pounds of glue, and four pounds of molasses.

HYACINTHS BLOSSOMING UNDER WATER.

Of late years it has been common in the London seed shops, to observe hyacinth glasses with the plants inverted, the flower appearing expanded in the water, where the roots usually are, and the bulb and roots being contained in a small pot of soil, and resting on the orifice of the glass. This is not shown with much effect in water glasses of the ordinary size, but when glasses are made twice or thrice the usual size, the effect is more striking; though it is merely the same thing on a larger scale. Sometimes a glass appears with one inverted plant, with its flowers fully expanded in water, and another plant directly over it, growing erect, with its flowers fully expanded in the open air; the bulbs and roots of both plants being in the same pot, or in two pots, placed bottom to bottom.

By what means are the blossoms made to expand in water? They are first made to expand in air, in one or two ways: first, by the common mode of growing hyacinths in pots, and when the flower is expanded, introducing it into the glass, and filling it up with water; and secondly, by inverting the pot over the top of the glass, and tying it in that position after the bulb is planted, so that the plant may grow into the glass, in which, of course, there is no water, and after the blossom has expanded there, introducing the water. A necessary precaution, according to this last mode, is to keep the glass, and of course the bulb, and the pot in which it grows in a horizontal position, near the light, and to turn them as often as the hyacinth appears to be growing to one side.

With respect to the mode of growing hyacintha in water glasses, it is commonly thought to be necessary to change the water whenever it appears to become muddy, but, though this is frequently done in England, it is as frequently omitted in

Holland, and the Dutch florists say that they perceive no disadvantages from the practice.*

* In order to get both glasses quite full of water, proceed thus:—Put the plant in its proper position in the smaller glass, and invert the other glass over it. Holding it loosely there, immerse the whole together sideways in a tub of water. When both glasses are thus filled, hold them close together—turn them in the required position that they are to remain in, and lift them up, taking care only that the smaller glass is topmost. It is immaterial whether the plant itself be reversed or not.

LONGEVITY OF BEES.

This is a subject upon which, we believe, no precise information has ever been presented to the public. "Cool courage and steady perseverance, crowned with unincumbered leisure," says Dr. Evans, "can alone expect to unlock this curious arcanum in natural history.

"The opinions of the ancients respecting it were extremely vague and indefinite. The length of life allotted by *them* to the *working bees* was from *seven* to *ten* years: in later times, writers on bees have regarded it as not much exceeding *a year;* but the notions of both ancients and moderns, upon this subject, have been purely conjectural.

"A good family of bees being known to consist of from 12,000 to 20,000, and a fertile queen to breed that number, at least every year, which, under favorable circumstances, is usually thrown off by swarming, it appeared to follow, as a matter of course, that if swarming were prevented by affording hive-room to the bees, the number during the breeding season would often be more than doubled, and that, if their lives were extended even to the shortest period hitherto assigned them, they would remain in a crowded state till the following spring. But repeated experience has clearly shown that the population of families, which have been thus accommodated with room, if examined in the following winter, do not consist of more than 2000 or 3000. After receiving a great increase in the ensuing spring, they again suffer a similar reduction before the succeeding winter; and this regular alteration of increase and decrease will go on for years, keeping a family that has been duly supplied with hive-room, at about the same average amount at each respective period of the year. This reduction to the smaller number above stated, every successive winter, can only be produced by the old bees dying, and leaving the business of the family to be conducted by the young ones; and it affords, I think, conclusive evidence, that the *working bee's* life is regularly cut off in *less than a year.*

"The period at which the queen bee deposits her greatest number of eggs is the spring, and it has been emphatically called *the great laying.* I think the facts above stated amply justify the opinion, that all the bees brought into existence by this laying, die before winter, and are succeeded by those hatched at intervals during summer and autumn, and in mild weather, during part of the winter also. The proportion of eggs deposited by the queen at these latter layings, when compared with the great laying in spring, accounts satisfactorily upon the theory above stated, for the great disparity in the populousness of a storified or collateral family of bees, at different periods of the year. This view of the matter renders it more than probable, therefore, that *the life of the working bee does not exceed more than six or seven months.*"

This theory was propounded by Mr. Bevan to his apiarian friends several years ago, and which they all regarded as being invulnerable: Mr. Bevan writes on the subject as follows:—

"On the 13th of June, 1835, I introduced a prime swarm to my mirror hive, the early proceeding of which bore so close a resemblance to those which occurred to Mr. Dunbar, as reported in the 'Edinburgh Philosophical Magazine,' that I need not detail them here. On the 1st of July, when the queen was in the midst of her laying of drone-eggs, and when the hive was well stored with honey, eggs, and brood in all stages, I removed her majesty from the family. Though I watched assiduously from early morn till late at night, for several days, no agitation was perceptible. Still I concluded that the bees were aware of the loss they had sustained, as on the second day I perceived the foundation of four royal cells, which were closely attended to by the workers. The general business of the family went on with as much alacrity as usual, pollen was duly carried in, honey-cells were stored and sealed over, brood-cells cleared out and replenished with honey, and, in short, not the slightest evidence was afforded of the absence of the queen. The usual period for enlarging and sealing up the royal cells passed away, but they never proceeded beyond the state of acorn cups. There was, however, no remission in the attention paid to them by the workers. In a few days the young workers began to issue from their cells, and on the 13th of July, I perceived the first issue of drones. From this period both were to be seen emerging daily; the latter continued to come forth till the 25th. This state of affairs somewhat perplexed me, and as was natural gave birth to theorizing. Some might have said it was a case of instinct at fault: to me it appeared an instance of one instinct overpowering another. I have stated, that on the second day of the queen's removal, I perceived the rudiments of royal cells; I question much whether if, at that time, I had more narrowly inspected the combs, I might not have seen the acorn-cups when I removed her: if so, I should regard this as the cause of failure, for in case of their being found during her majesty's occupancy of the hive, the bees would naturally expect *her* to make the usual deposits in them, and the constant attention which they paid to these cells, by incessantly popping in their heads,

gives countenance to the opinion. That such was the expectation of the bees, receives still further countenance from the situation of these royal cradles; they were constructed upon the edges of the combs, as I believe the *natural* cradles of royalty always are; not formed by the breaking down of *worker-cells*, as is the case when *artificial* cradles are constructed. Admitting this to be a sound view of the matter, it would seem not improbable, considering the populousness of the stock, and the warmth of the weather, that, had I removed the queen a day or two earlier or a day later, one or more royal cradles would have been perfected; as in the first case there would most likely have been a formation of artificial ones, and a consequent raising of *artificial* queens; in the latter case there *might* have been a tenanting of the *natural* cells of royalty, and a maturation of *natural* queens. In both these respects I was disappointed; no queen was raised, and yet, though no substitute for the old one was presented to the family, there was no abatement of their watchfulness, nor any relaxation of their diligence.

"The circumstance under which this family of bees was placed, appeared to offer a favorable opportunity for ascertaining the age to which the life of the working bee as well as that of the drone might extend. I knew that all the young workers were hatched within three weeks after the removal of the queen, and all the drones within twenty-four days of that time. I carefully watched the proceedings of the family during the remainder of the year, but till the close of autumn nothing different was noticeable in their proceedings from what would have taken place if the queen had been with them, excepting that there was no massacre of the drones, nor any deposition of fresh ova; both the store and the brood-cells were richly furnished with honey. The hive was situated in an upper apartment of my dwelling-house, well protected from cold—the quicksilver in Fahrenheit's thermometer, which hung near them, seldom ranging below 45, and never lower than 43 degrees. The drones began to decline in number towards the end of October, and by the middle of November not a single drone remained. Soon after their extinction there was a gradual but manifest diminution of the working-bees. They continued decreasing till the 30th of December, when only thirteen remained alive: these were quite active on the morning of that day, but before night two of them had expired; the other three, when I retired to rest about eleven o'clock, were moving briskly about upon the comb, but when I rose next morning, (31st,) they also had closed their career. Apprehending when the family became very much reduced, that so small a numbe of bees would be unable to maintain a due degree of heat; I not only surrounded the hive with a thick coating of wool, but kept a fire in the apartmen night and day, which preserved a regular temperature of *between 50 and 60 degrees Fahrenheit.*

"*From this detail it will, I think, appear pretty* evident, that the average *life* of the drone is about four months, while that of the working-bee is extended to about six months.

"On the extinction of the family I took from the hive nearly twelve pounds of fine liquid honey.

"The result of this experiment, as respects the length of the working-bee's life, fully confirms, so far as a single experiment can do, the opinion which I had previously formed, and it receives additional strength from another that was instituted by Reaumur. He marked 500 bees in April with red varnish, and saw them alive a month afterwards; but in the succeeding November not one of them could be distinguished. This circumstance, standing alone, cannot be regarded as conclusive; for, in the first place, the red varnish might have peeled off, prior to his last observation; and, in the next place, it is possible that none of the marked bees might have been spring bred; but, taken in conjunction with the facts detailed as having been noticed by myself, illustrating as they do the theory which precedes them, I think it may be received as strongly confirmatory of the opinion that the working-bee's life is much shorter than has usually been supposed, as it seems highly probable that at least *some* of the bees marked by Reaumur, if not all, were the produce of the spring laying, and whether or not the varnish and the bees had disappeared together, no doubt he observed in November a very manifest diminution in the populousness of the family.

"It now only remains that I should advert to the longevity of the queen-bee, and upon this point the evidence which we possess is sufficiently ample to justify a decisive statement. The experiments of Huber, Della Rocca, Dunbar, and Golding, have clearly proved that *her* majesty sees many generations pass away before she quits the stage herself. Huber, though he only speaks positively of her life being extended to two years, was of opinion, I believe, that it might reach to four or five; and three latter naturalists, by marking their queens, have traced them from hive to hive, through a period of *nearly four* years; a coincidence, in point of time, which, while it justifies the opinion of Huber, speaks strongly in favor of the diligent and acute observations of Della Rocca, Dunbar, and Golding. Della Rocca's queen had accidentally lost a leg in being hived, the others were distinguishable by having had one of their antennæ clipped, neither of which bereavements prevented the fulfilment of every royal function."

CRYSTALLIZATION.

The particles of matter are so small that nothing is known of their form, further than the dissimilarity of their different sides in certain cases, which appears from their reciprocal attractions during crystallization being more or less powerful, according to the sides they present to one another. Crystallization is an effect of molecular attraction, regulated by certain laws, according to which atoms of the same kind of matter unite in regular forms—a fact easily proved by dissolving a piece of alum in pure water. The mutual attraction of the particles is destroyed by the water; but if it be evaporated, they unite, and form in uniting, eight-sided figures called octahedrons. These, however, are not all the same. Some have their angles cut off, others their *edges*, and some both, while the remainder *take their regular form. It is quite clear that the same circumstances which cause the aggregation of* a few particles would, if continued, cause the addition of more; and the process would go on as long as any particles remain free round the primitive nucleus, which would increase in size, but would *remain unchanged in form*, the *figure of the particles* being such, as to maintain the regularity and smoothness of the surfaces of the solid and their mutual inclinations. A broken crystal will, by degrees, resume its regular figure, when put back

again into the solation of alum, which shows that the internal and external perticles are similar, and have a similar attraction for the particles held in solution. The original conditions of aggregation, which make the molecules of the same sabstance unite in different forms, must be very numerous, since of carbonate of lime alone there are many hundred varieties; and certain it is, from the motion of polarized light through rock crystal, that e very different arrangement of particles is requisite to produce an extremely small change in external form. A veriety of substances in crystallizing combine chemically with a certain portion of water, which in a dry state forms an essential part of their crystals; and according to the experiments of M. M. Haidinger and Mitscherlich, seems in some cases to give the peculiar determination to their constituent molecules. These gentlemen bave observed, thet the same substance, crystallizing at different temperatures, unites with different quantities of water, and assumes a corresponding variety of forms. Selenate of zinc, for exemple, unites with three different portions of water, and assumes three different forms, according as its temperature in the act of crystallizing is hot, lukewarm, or cold. Sulphate of soda, also, which crystallizes at 90 degrees of Fahrenheit, without water of crystallizetion, combines with water at the ordinary temperature, and takes a different form. Heat appeara to have a great influence on the phenomena of crystallization, not only when the particles of matter are free, but even when firmly united, for it dissolves their union and gives them another determination. Professor Mitscherlich, found that prismatic crystals of sulphate of nickel exposed to a summer's san in a close vessel, had their internal structare so completely altered, without any exterior change, that when broken open they were composed internally of octahedrons with aquare hases. The original aggregation of the internal particles bad been dissolved, and a disposition given to arrange themselves in a crystalline form. Crystals of sulphate of magnesia and of sulphate of zinc gradually heated in alcohol till it hoils, lose their transparency by degrees, and when opened are found to consist of innumerable minute crystals, totally different in form from the whole crystals; and prismatic crystals of zinc are changed in a few seconds into octahedrons, by the heat of the sun; other instances might be given of the influence of even moderate degrees of temperature on molecular attraction in the interior of substances. It must he observed, that these experiments give entirely new views with regard to the constitution of solid bodiea. We are led from the mobility of fluids to expect great changes in the relative positions of their molecules, which must be in perpetual motion even in the stillest water or calmest air; bnt we were not prepsred to find motion to such an extent in the interior of solids. That their particles are brought nearer by cold and pressure, or removed farther from one another hy heat might be expected; but it could not hava heen anticipated that their relative positione could be so entirely changed as to alter their moda of aggregation. It follows, from tha low temperature at which these changes are effected, that there is probably no portion of inorganic metter that is not in a state of relative motion.

Professor Mitscherlich's discoveries with regard to the forms of crystallized aubstances, as connected with their chemical character, have thrown additional light on the constitution of material bodies. There is a certain set of crystalline forms which are not susceptible of variation, as the die or cube, which may be small or large, bnt is invariably a solid bonnded by eix square snrfaces or planes. Such, also, is the tetrahedron or four-sided solid, contained by four equal-sided triangles. Several other solids belong to this class, which is called the Tessular system of crystallization. There are no other crystals which, though hounded by the same number of sides, and having the same form, ere yet susceptible of variation; for instance, the eight-sided figure with e square base, called an octahedron, which is sometimes flat and low, and sometimes acute end high. It was formerly believed. that identity of form in all crystals not belonging to the Tessular eystem, indicated identity of chemical composition. Professor Mitscherlich, however, has shown that eubstances, differing to e certain degrea in chemical composition, heve the property of assuming the same crystalline form. For example, the nentral phosphate of soda and the arseniate of soda, crystallize in the very same form, contain the same quantities of acid, alkali, and water of crystallization; yet they differ so far, that one contains arsenic, and tbe other an equivalent quantity of phosphorus. Substances having such properties are said to be isomorphous, that is, equal in form. Of these there are many groups, each group beving the same form, and similarity, though not identity of chemical composition. For instance, one of the isomorphous groups is that consisting of certain chemical substances called the protoxides of iron, copper, zinc, nickel, and magnanese, all of which are identical in form, and contain the same quantity of oxygen, but differ in the respective metals they contain, which are, however, nearly in the same proportion in each. All these circumstances tend to prove, that substances having the same crystalline form must consist of ultimate atoms, having the same figure, and arranged in the same order; so that the form of crystals is dependent on their etomic constitution.

All crystallized bodies have joints or cleavages, at which they split more easily than in other directions; on this the whole art of cutting diamonds depends. Each substance splits in a manner and in forms peculiar to itself. For example, all the hundreds of forms of carbonate of lime eplit into six-sided figures, called rhombohedrons, whosa alternate angles measure 105.55 degrees and 75.05 degrees, however far the division may be carried; therefore, the ultimate particle of carbonate of lime is presumed to bave that form. However this may be, it is certain that all the various crystals of that mineral may he formed by building up six-sided solids of tbe form described, in the same manner as children build houses with miniature bricks. It may be imagined that e wide difference may exist between the particlea of an unformed mass, and a crystal of tbe same substance—between the common shapeless limestone and the pure and limpid crystal of Iceland spar, yet chemical analysis detects none; their ultimate atoms are identical, and crystallization showa that the difference erises only from the moda of aggregation. Besides, all anbstances either crystallize neturally, or may be made to do so by art. Liquids crystallize in freezing, vapours by sublimation, and hard bodies, when fused, crystallise in cooling. Hence it mey be inferred that all substances are composed of atoms, on whose magnitude, density, and form their nature and qnalities depend; and as these qualities are unchangeable, the ultimete particles of matter must be incapable of wear.

PALM OIL.

BY DR. HENRY M'CORMACK.

The palm oil of commerce is obtained from the Cocos butyracea, which we are told is a native of Brazil. Now we find that the greater part, if not the whole of the palm oil in use, comes from the coast of Africa, by way of Liverpool and London. Then the cocos butyracea is either a native of Africa, which I take to be the case, or otherwise, the officinal palm oil of the Edinburgh Pharmacopœia, is procured from the African palm. This I know to be the case, from having seen the plant and its oil upon the spot, up the river Sierra Leone.

It is stated in our dispensaries, that the palm oil tree furnishes a yellow succulent fruit, with a fibrous pulp, containing a hard cartilaginous kernel, which last, by grinding and maceration, furnishes the oil. I shall now state the real process by which it is prepared, from which it will be seen that an error must have crept into our accounts on the subject.

The palm tree growing on the coast of Africa, furnishes at the base or origin of its leaves, clusters of a yellow succulent fruit. Each of these bears some resemblance to a grape shot. The bunches are of different sizes, and the fruit composing them of different shapes, as might be expected from their reciprocal pressure, although naturally round, when not exposed to it. The pulp of this fruit is soft, and of a bright yellow color—it is from this that the oil is obtained. Within it lies inclosed a hard and thick-shelled stone, of a dark color, within which is contained a firm white kernel of a pleasant oily flavor. This kernel also affords an oil, which is not yellow, but white—and not fluid, but concrete even in Africa. I need hardly say that the yellow palm oil is quite fluid while in Africa, and that it is not until it has been exposed to the cold of our temperate regions, that it becomes solid—whereas the oil of the kernel, as I have said, is always concrete, or nearly so.

Both the white and the yellow oil are obtained by expression. The latter is procured in immense quantities in Africa, where it is partly consumed by the negroes along with their rice and pepper, or fried with their fish; and partly exported to Europe, where its principal use is in the manufacture of soap.

It continues to possess a pleasant fragrant odour for a long time after its extraction, and holds the same importance among the necessaries of an African, that olive oil does among those of an Italian or Spaniard. It affords an amusing spectacle to a new comer to witness a number of merry negroes squatting on their hams round a calibash of rice. They seldom use a spoon, but knead the grain into huge balls, which they roll over in a mixture of pepper, salt, and oil, and then pitch them with unerring aim and surprising velocity into their mouths, whence they almost seem to descend unbroken into the stomach. The white oil is only used as an ointment for the skin, which it keeps nice and soft, while it at the same time prevents too great an excretion of perspiratory matter. Not content with the hue that nature had given them, I have sometimes seen fond mothers mix this oil with something like lamphlack and rub their children over from head to foot, giving them a singularly lustrous appearance, especially in the sun.

The palm tree is one of the most stately in the African forest, towering above the rest, as the lofty pine does at home over its fellow trees. Parrots are said to be fond of the fruit. I have seen it given to them after they were newly caught. Indeed the strong arched beak of this bird seems to render it peculiarly fit for tearing the fibres of fruit asunder. The preceding statement affords but a trifling addition to our knowledge, but as every thing helps to swell the great mass, I may be permitted to bring it forward.

MISCELLANIES.

Electrical Experiment.—Air is constantly blown *from* an electrified body, whether they be in a state of positive or negative electricity: thus a wheel placed on either of these will yet revolve always the same way, or in a direction opposite to the ends of the bent wires. In like manner a thick tapering wire will still project a stream of air, as indicated by the turning of a small wheel of cord. Hence the explication of a seemingly paradoxical fact, that any hot body will cool faster if kept electrified. To make this experiment in a satisfactory manner, gild a very large mercurial thermometer, having a ball perhaps of an inch or an inch and a half in diameter, and a long stem bearing only 30 or 40 degrees; suspend the instrument from an insulated stand, at the distance of two or three yards from the prime conductor, with which it communicates by a silver thread, apply the hand to the bulb of the thermometer and heat it up to 20 degrees above the temperature of the room, and note the time it takes to fall to the proper point, repeat the operation, and then keep turning the machine, and the mercury will be found to sink down in less than half that time.

Cleaning of Engravings.—Put the engraving on a smooth board, cover it thinly with common salt finely pounded; pour or squeeze lemon-juice upon the salt so as to dissolve a considerable portion of it; elevate one end of the board, so that it may form an angle of about 45 or 50 degrees with the horizon. Pour on the engraving boiling water from a tea kettle, until the salt and lemon-juice be all washed off; the engraving will then be perfectly clean, and free from stains. It must be dried on the board, or on some smooth surface gradually. If dried by the fire or the sun, it will be tinged with a yellow color. Any one may satisfy himself of the perfect efficacy of this method, by trying it on an engraving of small value.

Detection of the Traces of Writing fraudulently erased.—Professor Gazzari, of Florence, having been frequently appointed by the tribunals to give professional evidence on trials of this nature, instituted experiments on the subject, which, by showing him the possibility of removing not only the ink, but also the materials employed in its removal, proved that cases might arise when the fraud could not be detected in any other manner than by examining the condition of the paper or other material written on. For this purpose optical means were tried in vain, and immersion in water did not show such a difference in the absorptive power of the written and unwritten parts, as happens in the employment of certain sympathetic inks; but an exposure of the inspected paper to a moderate fire, the paper which, in consequence of the corrosive effects of the ink, was in those parts altered in its nature, was unequally acted on by the process of carbonization, and thus the number and length of the lines, and often the whole of the erased portion were distinctly revealed.

Fig. 1.

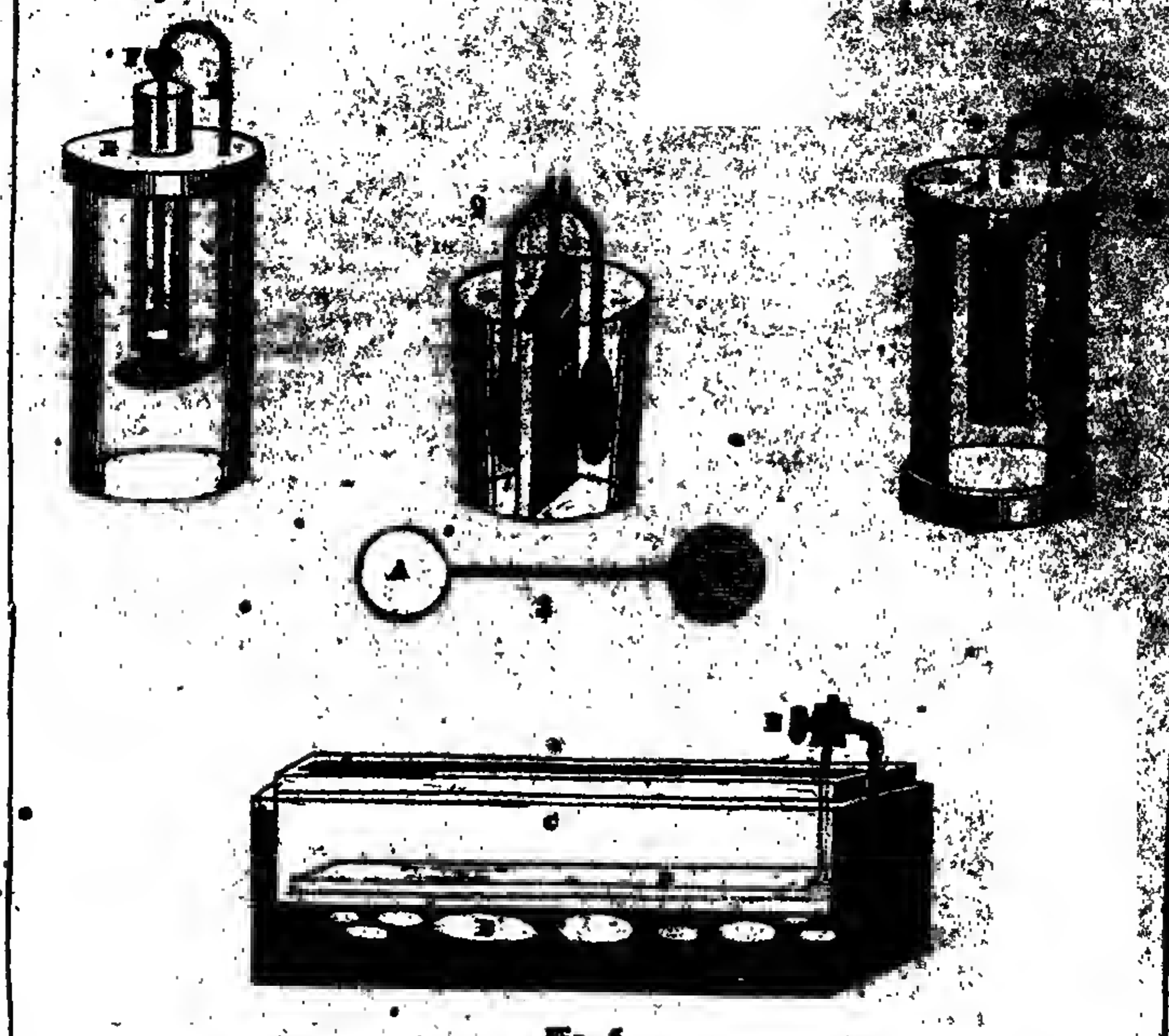


Fig. 5.

THE ELECTRO-TYPE; OR ENGRAVING BY VOLTAIC ELECTRICITY.

We have already, in page 199, given an account of this curious process; since that time we have made many experiments upon the subject, as well as read the papers published by its original discoverer, Mr. Spencer, of Liverpool. So much attention have these last discoveries now excited, that we believe a fuller description of the process, hints for its success, and an account of the simple apparatus employed, will be acceptable to our readers, especially when we promise that the medals thus formed are exquisite [illegible] sharpness, and so easy to manufacture, [illegible] impossible to err in the process, or to fail in [illegible]. It is but fair, as well as more satisfactory, to explain it in Mr. Spencer's own words, more especially as they are so plain and explicit, as to leave us nothing more to desire. The following paper, (with the exception of the description of apparatus,) is abridged from his papers, read before the Liverpool Society:—

My first essay was a piece of thin copper-plate, having about four inches of [illegible], with an equal-sized piece of zinc, [illegible] with a piece of copper wire. I gave the [illegible] coating of soft cement, consisting of bees' wax, [illegible] and a red earth—Indian or Calcutta red. The plate [illegible] its coating while hot. On cooling, I scratched the initials of my own name rudely on the [illegible], taking special care that the cement was quite [illegible] from the scratches, that the copper might [illegible] exposed. This was put in action, in a [illegible] glass vessel about half filled [illegible] solution of sulphate of copper. I [illegible] mon gas-glass, similar to that [illegible] Argand burner, and [illegible] one end [illegible] of Paris, to the [illegible] I put some water, [illegible] of soda, to excite [illegible] as a partition to [illegible] porous to allow the [illegible] fluid to permeate its substance.

"I now bent the wires in such a form that the zinc end of the arrangement should be in the saline solution, while the copper end should be in the cupreous one. The gas glass, with the wire, was then placed in the vessel containing the sulphate of copper.

"It was then suffered to remain, and in a few hours I perceived that action had commenced, and that the portion of the copper rendered bare by the scratches was coated with the pure bright deposited metal; whilst all the surrounding portions were not at all acted on."

The various cuts introducing our present number, will render evident the foregoing and following experiments. Fig. 1 represents the apparatus used by Mr. Spencer, as above mentioned; A is a glass, or other vessel, holding about a pint. B is a wooden cover, fitted on the top of it. C is the lamp glass, fixed in the middle of the cover, and furnished with the plaster of Paris bottom. D is a wire having a piece of zinc at the bottom of it, and a wooden cup, F, for the sake of convenience of connection at the top. E is a second wire passing through the wooden top, and bent below, where it has the plate of copper fastened to it. If the two wires, D and E, are soldered, or tied tightly together, the mercury cup may be dispensed with.

Fig. 2 represents a common drinking glass, having a sheet of plaster of Paris across it, and fastened there by a little liquid plaster poured round the edges, which not only keeps it firmly fixed but prevents leaking from one side to the other. A is the glass or tumbler. B is the sheet of plaster. C is the plate of zinc, connected with a wire with the plate of copper at D. The wire is in the figure supported by a forked piece of wood on the top of the plaster division, but this is not necessary.

Fig. 3 shows the wire and its two plates A and B, soldered together, and ready for immersion, with the exception of bending the wire.

Fig. 4 is an apparatus for the same purpose, and of very similar construction to No. 1. A is the glass vessel. B the wooden top. C a tube formed of porous earthenware. D the piece of zinc. E the wire bearing the copper coin; and F. the binding screw, which unites tightly the two wires together.

Fig. 5 is an apparatus upon a larger but similar construction. A is a square glass vessel. B a plate of copper holding several medals upon it, all of which are either united by soldering to the copper plate, or else united to it by a drop of quicksilver on the edge of the medal. C is a box made of plaster of Paris, fitting into the glass box A, but prevented touching the bottom of it, either by props underneath, or else projecting ledges at each end. D is the plate of zinc. E is the screw that binds together the two wires,—by this simple apparatus a number of objects may be made at once.

"*To Engrave in Relief on a Plate of Copper.*—Take a plate of copper, such as are in use among engravers. It is not essential that it should be highly polished.

"Have a piece of copper wire neatly soldered to the back part of it, and then give it a coating of the cement already mentioned. This is best done by heating the plates as well as the wax; or, to level the wax after it has had a coat, hold the back part of the plate over a charcoal fire, or spirit lamp—taking care to hold it level.

"Then write, or draw the design on the wax, with a black-lead pencil or a point. The wax must now be cut through with a graver, or a steel point—taking especial care that the copper *is exposed on every line.*

"It must now be immersed in dilute nitric acid say, three parts water to one acid. It will be once seen whether it is strong enough, by the green color of the solution, and the bubbles of nitrous gas eliminated. Let it remain long enough to allow the exposed lines on the plate to be *slightly* corroded, that the wax (which gets into the pores of the copper during the heating process), may be thoroughly got rid of. Practice will determine this better than any rules.

"The plate is now ready to be placed in the voltaic apparatus. After the voltaic copper has been deposited in the lines engraved in the wax the surface of the formation will be found to be rough, more or less, according to the quickness of the action. To remedy this, rub the surface with a piece of smooth flag or pumice-stone, with water. Then heat the plate, and wash off the wax ground-work with spirits of turpentine and a brush. The plate is now ready to be printed from at an ordinary press.

"*To Deposit a Solid Voltaic Plate, having the Lines in Relief.*—Take a plate of copper, lead, silver, or type-metal, of the required size, and engrave in it, to the depth requisite to print from, when in relief.

"Contrary to ordinary engraving, the lines must be *flat* at the bottom, and as nearly as possible of the same depth, when so engraved, (should the plate be copper or silver), heat it, and then apply a little bees' wax, (what is termed virgin wax is preferable,) mixed with a very small proportion of spirits of turpentine; and give the plate a coating of it. It may be laid on in a lump; and the heat of the plate should be sufficient to melt it. When on the eve of cooling, the plate should be wiped clean, and all the wax taken off,—as sufficient will have entered the pores of the plate to prevent the voltaic copper from adhering.

"Then solder a piece of copper wire.

"The plate must now receive a couple of coats of thick varnish on the back and edges, (a preparation of shell-lac and alcohol does very well.) I prefer, if the plate is large, to imbed it with plaster of Paris or Roman cement, in a box the size of the plate, allowing the wooden edge of the box to project just as much above the surface of the plate, as you wish the thickness of the voltaic one to be. (Care must be taken, to keep the engraved surface of the plate clean.)

"It is now ready to be placed in the apparatus to be deposited on.

"Should the plate be lead, or what is still better, type-metal, the preparation of wax does not require to be given to the plate, as, when it is deposited on to the given thickness, applying heat is sufficient to loosen the plates."

(495.)

PHENOMENA OF SPRINGS.

(*Resumed from page 380, and concluded.*)

Mineral and Thermal Springs.—Almost all springs, even those which we consider the purest, are impregnated with some foreign ingredients which, being in a state of chemical solution, are so intimately blended with the water, as not to affect its clearness, while they render it, in general, more agreeable to our taste, and more nutritious

than rain-water. But the springs called mineral contain an unusual abundance of earthy matter in solution, and the substances with which they are impregnated correspond remarkably with those evolved in a gaseous form by volcanoes. Many of these springs are thermal, and they rise up through all kinds of rock; as, for example, through granite, gneiss, limestone, or lava, but are most frequent in volcanic regions, or where violent earthquakes have occurred at eras comparatively modern.

The water given out by hot springs is generally more voluminous and less variable in quantity at different seasons than that proceeding from any other. In many volcanic regions jets of steam, called by the Italians *stufas*, issue from fissures, at a temperature high above the boiling point, as in the neighbourhood of Naples, and in the Lipari Isles, and are disengaged unceasingly for ages. Now, if such columns of steam, which are often mixed with other gases, should be condensed before reaching the surface, by coming in contact with strata filled with cold water, they may give rise to thermal and mineral springs of every degree of temperature. It is, indeed, by this means only, and not by hydrostatic pressure, that we can account for the rise of such bodies of water from great depths; nor can we hesitate to admit the adequacy of the cause, if we suppose the expansion of the same elastic fluids to be sufficient to raise columns of lava to the lofty summits of volcanic mountains. Several gases, the carbonic acid in particular, are disengaged in a free state from the soil in many districts, especially in the regions of active or extinct volcanos; and the same are found more or less intimately combined with the waters of all mineral springs, both cold and thermal. Dr. Daubeny and other writers have remarked, not only that these springs are most abundant in volcanic regions, but that when remote from them, their site usually coincides with the position of some great derangement in the strata; a fault, for example, or great fissure, indicating that a channel of communication has been opened with the interior of the earth at some period of local convulsion.

These springs derive their chief importance to the geologist from the quantity and quality of the earthy materials which they hold in solution. These consist of a great variety of substances; but the most predominant are, carbonate of lime, carbonic and sulphuric acids, iron silica, magnesia alumine, and salt, besides petroleum, or liquid bitumen, and its various modifications, such as mineral pitch, naphtha, and asphaltum.

Calcareous Springs.—Our first attention is naturally directed to springs which are highly charged with calcareous matter; for these produce a variety of phenomena of much interest. It is known that rain-water has the property of dissolving the calcareous rocks over which it flows, and thus, in the smalle[illegible]s and rivulets, matter is often supplied for t[illegible]y secretions of testacea, and for the growth of certain plants on which they feed. But many springs hold so much carbonic acid in solution, that they are enabled to dissolve a much larger quantity of calcareous matter than rain-water; and when the acid is dissipated in the atmosphere, the mineral ingredients are thrown down, in the form of tufa, or travertin.

Sulphureous and Gypseous Springs.—The quantity of other mineral ingredients wherewith springs in general are impregnated, is insignificant in comparison to lime, and this earth is most frequently combined with carbonic acid. But as sulphuric acid and sulphuretted hydrogen are very frequently supplied by springs, gypsum may perhaps, be deposited largely in certain seas and lakes. The gypseous precipitates, however, hitherto known on the land, appear to be confined to a very few springs. Those at Baden, near Vienna, which feed the public bath, may be cited as examples. Some of these supply, singly, from 600 to 1000 cubic feet of water per hour, and deposit a fine powder, composed of a mixture of sulphate of lime, with sulphur and muriate of lime.

Siliceous Springs.—Azores.—In order that water should hold a very large quantity of silica in solution, it seems necessary that it should be raised to a high temperature; and as it may retain a greater heat under the pressure of the sea than in the atmosphere, submarine springs may, perhaps, be more charged with silex than any to which we have access. The hot springs of the Valle das Furnas, in the island of St Michael, rising through volcanic rocks, precipitate vast quantities of siliceous sinter, as it is usually termed. Around the circular basin of the largest spring, which is between twenty and thirty feet in diameter, alternate layers are seen of a coarser variety of sinter mixed with clay, including grass, ferns, and reeds in different states of petrifaction. Wherever the water has flowed, sinter is found rising in some places eight or ten inches above the ordinary level of the stream. The herbage and leaves, more or less incrused with silex, are said to exhibit all the successive steps of petrifaction, from the soft state to a complete conversion into stone; but, in some instances, alumina, which is likewise deposited from the hot waters, is the mineralizing material. Branches of the same ferns which now flourish in the island are found completely petrified, preserving the same appearance as when vegetating, except that they acquire an ash-grey color. Fragments of wood, and one entire bed from three to five feet in depth, composed of reeds now common in the island, have become completely mineralized.

Ferruginous Springs.—The waters of almost all springs contain some iron in solution; and it is a fact familiar to all, that many of them are so copiously impregnated with this metal, as to stain the rocks or herbage through which they pass, and to bind together sand and gravel in solid masses. We may naturally, then, conclude that this iron, which is constantly conveyed from the interior of the earth into lakes and seas, and which does not escape again from them into the atmosphere by evaporation, must act as a coloring and cementing principle in the subaqueous deposits now in progress. It will be afterwards seen that many sandstones and other rocks in the sedimentary strata of ancient lakes and seas are bound together or colored by iron, and this fact presents us with a striking point of analogy between the state of things at very different epochs. In those older formations we meet with great abundance of carbonate and sulphuret of iron; and in chalybeate waters at present, this metal is most frequently in the state of a carbonate, as in those of Tunbridge, for example. Sulphuric acid, however, is often the solvent, which is in many cases derived from the decomposition of pyrites.

Brine Springs.—Cheshire.—So great is the quantity of muriate of soda in some springs, that they yield one fourth of their weight in salt.

They are rarely, however, so saturated, and generally contain, intermixed with salt, carbonate and sulphate of lime, magnesia, and other mineral ingredients. The brine springs of Cheshire are the richest in our country; those of Barton and Northwich being almost, and those of Droitwich fully saturated. They are known to have flowed for more than 1000 years, and the quantity of salt which they have carried into the Severn and Mersey must be enormous. These brine springs rise up through strata of sandstone and red marl, which contains large beds of rock salt. The origin of the brine, therefore, may be derived in this and many other instances from beds of fossil salt; but as muriate of soda is one of the products of volcanic emanations and of springs in volcanic regions, the original source of salt may be as deep seated as that of lava.

Carbonated Springs.—Auvergne.—Carbonic acid gas is very plentifully disengaged from springs in almost all countries, but particularly near active or extinct volcanos. This elastic fluid has the property of decomposing many of the hardest rocks with which it comes in contact, particularly that numerous class in whose composition felspar is an ingredient. It renders the oxide of iron soluble in water, and contributes, as was before stated, to the solution of calcareous matter. In volcanic districts these gaseous emanations are not confined to springs, but rise up in the state of pure gas from the soil in various places. The Grotto del Cane, near Naples, affords an example, and prodigious quantities are now annually disengaged from every part of the Limagne d'Auvergne, where it appears to have been developed in equal quantity from time immemorial. As the acid is invisible, it is not observed, except an excavation be made wherein it immediately accumulates, so that it will extinguish a candle. There are some springs in this district, where the water is seen bubbling and boiling up with much noise, in consequence of the abundant disengagement of this gas. The whole vegetation is affected, and many trees, such as the walnut, flourish more luxuriantly than they would otherwise do in the same soil and climate—the leaves probably absorbing carbonic acid.

Petroleum Springs.—Springs impregnated with petroleum, and the various minerals allied to it, as bitumen, naphtha, asphaltum, and pitch, are very numerous, and are, in many cases, undoubtedly connected with subterranean fires, which raise or sublime the more subtle parts of the bituminous matters contained in rocks. Many springs in the territory of Modena and Parma, in Italy, produce petroleum in abundance; but the most powerful, perhaps, yet known, are those on the Irawadi, in the Burman empire. In one locality there are 520 wells, which yield annually 400,000 hogsheads of petroleum.

Fluid bitumen is seen to ooze from the bottom of the sea, on both sides of the island of Trinidad, and to rise up to the surface of the water. Near Cape La Braye there is a vortex which, in stormy weather, according to Captain Mallet, gushes out, raising the water five or six feet, and covers the surface for a considerable space with petroleum, or tar; and the same author quotes Gumilla, as stating in his "Description of the Orinoco," that about seventy years ago, a spot of land on the western coast of Trinidad, near half way between the capital and an Indian village, sank suddenly, and was immediately replaced by a small lake of pitch, to the great terror of the inhabitants.

Pitch Lake of Trinidad.—It is probable that the great pitch lake of Trinidad, owes its origin to a similar cause; and Dr. Nugent has justly remarked, that in that district all the circumstances are now combined from which deposits of pitch may have originated. The Orinoco has for ages been rolling down great quantities of woody and vegetable bodies into the surrounding sea, where by the influences of currents and eddies, they may be arrested and accumulated in particular places. The frequent occurrence of earthquakes and other indications of volcanic action in those parts, lend countenance to the opinion that these vegetable substances may have undergone, by the agency of subterranean fire, those transformations and chemical changes which produce petroleum, and this may, by the same causes, be forced up to the surface, where, by exposure to the air, it becomes inspissated and forms the different varieties of pure and earthy pitch, or asphaltum, so abundant in the island.

VENTRILOQUISM.

(From Dr. Arnott's Physics.)

Ventriloquism is the name commonly given to the art by which an individual can assume characters of voice and speech which are not natural to him, and thus, although alone, can imitate closely a conversation held between two or more persons.

The most remarkable diversity is obtained by speaking during inspiration instead of, as usual, during expiration. The voice so produced is more feeble than the ordinary voice, and when accompanied by other circumstances favoring the illusion, it may suggest very completely the idea of a boy calling from the bottom of a pit, or from the interior of a chimney, &c. An unsuspecting peasant may be tricked into unloading his hay-waggon by an expert ventriloquist, who makes him believe that there is a poor child packed under the heap and ready to be smothered there.

A person, by a little practice, may acquire the power of producing, without the slightest apparent motion of the lips or countenance, all the articulations except the labial, and of them the F, V, and M, may be tolerably imitated by parts behind; hence by avoiding words in which P and B occur, such persons may speak without visible movement of the organs, and if he assume the attitude of a listener, he may make the deception of ventriloquism complete. The idea which some authors have had *(see Good's "Study of Medicine," &c.)* that the articulations of the ventriloquist are not produced by the tongue and mouth, as in common speech, is altogether an error. The art, carried to a certain degree, is not very difficult, as any person may ascertain who tries it, after considering minutely the nature of common speech.

There are also striking varieties of voice producible by speaking with a more acute or grave pitch than usual, and with different degrees of contraction of the mouth; but these may be more properly called *imitations* than *ventriloquism.*

The variety of effect in sound which the human organs are capable of producing is truly surprising. There are adepts in the art of imitations, who not only mimic the speech of all ages and conditions of the human race, but the songs of birds, the cries of animals, and even not a few of the sounds of inanimate things. Many of these performances become in the highest degree ludicrous, and furnish favorite amusements in our theatres. A Mr. Henderson, of

London, about the end of the eighteenth century, used to *kill his calf*, as he called it, to crowded houses every night. After dropping a screen between him and the audience, he caused to issue from behind it all the sounds, even to the minutest particular, which may be heard while a calf is falling a victim in the slaughter-house; the conversation of the butchers, the struggling and bellowing and quick breathing of the frightened animal, the whetting of the knife, the plunge, the gush, the agony;—and revolting as the occasion is in itself, the imitation wes so true to nature, that thousands eagerly went to witness the art of the mimic.

The following cases of inanimate sound may be closely imitated by the mouth:—The working of a grindstone, including the noise of the water into which it dips, the rough attrition of the steel upon it, and the various changes occurring with change of the pressure;—the working of a saw cutting wood;—the uncorking of a bottle, and the guggling noise of decanting its contents;—the sound of air rushing into a room in a winter night by e crevice or key-hole—and many others.

ENAMELLING.

(*Resumed from page* 384, *and concluded.*)

Composition of the White Enamel.—The exact composition of the opaque white enamel is a matter of considerable importance. A good anamel of this kind, fit to be applied to porcelain and metals, should be of a very clear fine white, so nearly opaque, es only to be translucent at the edges; and at a moderate red beat it should run inte that kind of paste, or imperfect fusion, which allows it to extend itself freely and uniformly, and to acquire a glossy even surface, without, however, fully melting into thin glass. The opaque white of this enamel is given by the oxide of tin, which possesses, even in a small proportion, the property of rendering vitrescent mixtures white and opaque; or in still less proportion, milky; and when otherwise colored, opalescent. The oxide of tin is always mixed with three or four times its quantity of oxide of lead; and it eppears necessary that the metals should be previously mixed by melting, and the alloy then calcined. The following are the directions given by M. Clouet for the composition of this enamel:—

Mix 100 parts of pure lead with 20 to 25 of the best tin, and bring them to a low red heat in an open vessel. The mixture then burns nearly as rapidly as charcoal, and oxidates very fast. Skim off the crusts of oxide successively formed, till the whole is thoroughly calcined. It is better than to mix all the skimmings, and again beat as before, till no flame arises from them, and the whole is of an uniform grey color. Take 100 parts of this oxide, 100 of sand, and 25 or 30 of common salt, and melt the whole in a moderate heat. This gives a greyish mass, often porons and apparently imperfect, but which, however, runs to a good enamel when afterwards fused. This is the enamel used for porcelain; but for metals and finer works, the sand is previously calcined in a very strong heat with a fourth of its weight; or, if e more fusible compound is wanted, as much of the oxides of tin and lead as of salt are taken, and the whole is melted into a white porous mass. This is then employed instead of the rough sand, as in the above-mentioned process.

The above proportions, however, are not invariable, for if more fusibility is wanted, the dose of oxide is increased, and that of the sand diminished; the quantity of common salt remaining the same. The sand employed in this process, according to M. Clouet, is not the common sort, however fine; but a micaceous sand, in which the mica forms about one-fourth of the mixture.

Another Form of Composition.—Neri, in his valuable treatise on glass making, has long ago given the following proportions for the common material of all the opaque enamels, which Knuckel and other practical chemists have confirmed. Calcine 30 parts of lead, with 33 of tin, with the precautions mentioned above. Take of this calcined mixed oxide 50 pounds, and as much of powdered flints (prepared by being thrown into water when red hot, and then ground to powder), and eight ounces of salt of tartar; melt the mixture in e strong fire kept up for ten hours, after which reduce the mass to powder. This is the common material for the opaque enamels, and is of a grey white color. To make this fine enamel quite white, mix six pounds of the compound with 48 grains of the best black oxide of manganese, and melt in a clear fire. When fully fused, throw it inte cold water, then re-melt and cool, as before, two or three times, till the enamel it quite white and fine.

Knuckel observes on this process, that he tried it without the oxide of manganese, but the enamel, instead of being milk white, was blueish and not good; so that there is no doubt but that this oxide is highly important. If too much is used, the enamel becomes of a rose purple.

Enamel of a rich Red Color.—Colored enamels are composed of a common basis, which is a fusible mixture of vitrifiable materials, and of some metallic oxide. In general, the colored enamels are required to be transparent, in which case the basis is a kind of glass composed of borax, sand, and oxide of lead, or other vitrescent mixtures; in which the proportion of saline, or metallic flux, is more or less according to the degree of beat that the coloring oxide will bear without decomposition. When the colored enamel is te be opaque, or opalescent, a certain portion of the white opaque enamel, or of the oxide of tin, is added to the mixture. The most beautiful and costly color known in enamelling is an exquisitely fine rich red, with a purplish tinge, given by the salts and oxides of gold; especially by the purple precipitate, formed by tin in one form or other; and by nitro-muriate of gold; and also by the fulminating gold. This beautiful color requires much skill in the artist to be fully brought out. It is said, that when most perfect, it should come from the fire quite colorless, and afterwards receive its color by the flame of a candle. Gold colors will not bear a violent fire.

Other and common reds are given by the oxide of iron; but this requires the mixture of alumine, or some other substance, refractory in the fire, otherwise at a full red beat the color will degenerate into black.

Yellow Enamel.—Yellow is given either by the oxide of silver alone, or by the oxide of lead and antimony, with similar mixtures to those required for iron. The silver is as tender a color as gold, and is readily injured or lost in a high heat.

Green Enamel.—Green is given by the oxide of copper, or it may also be procured by a mixture of blue and yellow colors.

Blue Enamel.—Blue is given by oxide of cobalt; and this seems of all enamel colors, the most certain and easily manageable.

Black Enamel.—Black is produced by a mixture of oxides of cobalt and manganese.

The reader mey conceive how mnch the difficulties of this nice art are increased, when the object is not merely to lay an uniform colored glazing on a metallio surface; bnt also to paint that surface with figures and other designs that require extreme delicacy of ontline, eccuracy of shading, and selection of coloring. The enamel painter has to work, not with actual colors, bnt with mixtures which he only knows from experience will produce certain colors after the delicate operation of the fire; and to the common skill of the painter, in the arrangement of his pallet and choice of his colors, the enameller has to add much practical knowledge of the chemical operation of one metallic oxide on another; tha fusibility of his materials; and the ntmost degree of heat at wbich they will retain, not only the accuracy of the figures which he has given, but the precise shade of color which he intends to lay on.

Painting in enamel reqnires a succession of firings; first of the ground which is to receive the design and which itself requires two firings, and then of the different parts of the design itself. The ground is laid on in the same general wey as the common watch face enamelling, already described. The colors are the different metallio oxides, melted with some vitrescent mixture, and ground to extreme fineness. These are worked up with an essential oil (that of spikenard is preferred, and next to it oil of lavender) to the proper consistence of oil colors, and are laid on with a very fine hair brush. The essential oil should be very pure, end the use of this, rather than of any fixed oil, is, that the whole may evaporate completely in a moderate heat, and leave no carboneceous metter in contact with the color when red hot, which might affect its degree of oxidetion, and thence the shade of color which it is intended to produce. Ae the color of some vitrified metellic oxides (such as that of gold), will atand at a very moderate heat, whilst others will bear, and even require a higher temperstnre to be properly fixed, it forms a great part of the technical skill of the artist to supply the different colors in proper order; fixing those shades whicb are produced by the colors thet will endnre the bighest, and finishing with those thet demand the least heat. The ontline of the design is first traced on the enamel, ground and burnt in; after which, the parts are filled np gradually by repeated burnings, to the last and finest touches of the tenderest enamel.

Transparent enamels are scarcely ever laid npon any other metal than gold, on eccount of the discoloration produced by other metals, as already explained. If, bowever, copper is the metal used, it is first covered with a thin enamel coating, over which gold leaf is laid and burnt in, so that, in fact, it is still this metal that is the basis of the ornamental enamel. With regard to the vast number of important minntiæ in the selection and order of applying the colors, the management of the fire, &c. &c., almost the whole of what is known, on this subject, is confined to the practical artist.

PLASTER CASTS OF FOLIAGE, &c.

THE following are the particulars of Mr. Doeble's process: The leaf as soon as convenient after being gathered, is to be laid on fine-grained moist sand, in a perfectly natural position; having thet surface uppermost which is to form the cast; and being banked np by sand, in order thet it may be perfectly supported. It is then, by means of a broad camel-hair brush, to be covered over with a thin coating of wax and Burgundy-pitch; rendered fluid by heat. The leaf being now removed from the sand and dipped in cold water, the wax becomes hard, and at the same time sufficiently tough to allow the leaf to oe ripped off without altering its form. This being done, the wax mould is placed on moist sand, and banked np as the leaf itself was; it is then covered with plaster of Paris made thin, care being taken that the plaster is accurately forced into all the interstices of the mould by means of a camel-hair brush. As soon as the plaster is eet, the warmth thus produced softens the wax, wbich in consequence of the moisture of the plaster is prevented from adhering thereto; and with a little dexterity it may be rolled np, parting completely from the cast, withont injuring it in the smallest degree.

Casts thus obtained are very perfect, have a high relief, and are excellent models, either for the draughtsman, or for the moulder of architectural ornaments.

BRONZING.

WHAT is called bronzing is giving to the articles an eppearance similar to that assumed by statues, and other ornamental works, which are mede of the compound of copper and tin, known under the name of bronze. In them the metallic surface becomes corroded by exposure, and in general appears of an intense green color; whilst the more prominent parts, being most subjected to friction, retain e portion of metallic lustre.

Different modes of producing this effect are pursued; but they all consist in covering the [illegible] to be bronzed, either with water or oil paint, [illegible] desired color, and then rubbing a metallic powder npon the projecting parts.

The first thing to be attended to in this art, is the preparation of the bronze to be used. Many receipts have been given for prepering this, but the two following we think decidedly the cheapest and the best we heva seen.

Receipt for making Green Bronze.—Take one qnart of strong vinegar; half an ounce of mineral green; half an ounce of raw umber; half an ounce of sal-ammoniac; half an ounce of gum-arabic; two ouoces of French berries; half an ounce of copperas; and ebout three ounces of green oats, if these can be procured; although, if they cannot, the preparation will succeed perfectly well withont them. Dissolve the different salts and gums, in small portions of vinegar; then mix the whole in a etrong earthen vessel, adding the berries and the oats, over a gentle fire: bring the compound to boil. Then allow it to cool, and filter it through a flannel beg, when the bronze will be fit for use.

Receipt for making Bronze commonly used by Brass-founders.—Take one English pint of strong vinegar; one ounce of sal-ammoniac; half an ounce of alum; a quarter of an ounce of arsenic; dissolve them in the vinegar, and the compound is fit for use. We know brass-founders who heve been in the habit of using this cheap composition for several years; and, where the metal is good, it is very seldom found to fail.

The bronze being now prepared, the next thing to be ettended to is the cleaning of the brass-work to be bronzed, and the best method for—

Cleaning work previous to using Bronze is either by filing, turning, rubbing with sand-paper, or dipping in aqua-fortis. It is absolutely necessary, in order to be successful, to have the work well cleaned, and free from grease, especially; and the latter of these methods is certainly the best, and therefore ought always to be used when it is wished to succeed particularly well, although any of the above methods are perfectly sufficient for ordinary purposes.

Having thus got the bronze and the work ready, we now proceed to describe the manner.

Bronzing Brass-work.—This must be done with a small brush, and great care must be taken to keep the work constantly wet with the liquid, to prevent it from turning green. When the color which is wished has been attained, which will generally be in from twenty to thirty minutes, the work must be quickly washed in clean cold water, and then dried in soft warm sawdust, after which the whole is laid over with a coating of lacker, which preserves the colors.

It often happens, however, from the quality of the brass, that the bronze will not bring the work to a sufficiently dark color; means must be used to remedy this defect, and we think—

The best and cheapest method of giving a proper dark tinge to Bronze, when, from the nature of the metal, we cannot otherwise succeed, is the following:—Mix about a quarter of an ounce of the finest lamp black, with about one gill of strong spirit of wine, and strain the mixture through a fine linen cloth. The work on which the bronze has been already used, must then be warmed upon a cistern plate, or over a clear fire, until it can scarcely be held in the hand. Then, with a fine camel-hair brush, such as is used for lackering, the work must be laid over with this mixture, in very thin coatings, until the shade required be obtained. When cold, it must be polished with a very soft brush, or piece of linen rag, dipped or moistened with clear green oil. A coating of lacker is then laid over the whole, and the most beautiful bronze will be obtained that can be produced on brass; and, if the work is not made too black with the mixture, nor the lacker used of too bright a yellow, the bronze obtained, will be a beautiful dark green —the color now so much used by the English brass-founders. By this it will be seen, that any shade of what is called green bronze can be obtained, simply by using more or less of the blacking, and a lighter or darker color of the yellow lacker; and the different tints wished to be given to the work will of course be obtained by the different thickness of the coatings of blacking which the several parts of the work receive. The work, however, will stand much longer in color, when the bronze can be made sufficiently dark, without using the blacking at all; and this can be done, although it takes no longer time than is required when the blacking is used.

Method of giving Bronze the proper shade without using blacking. — When either of the bronzes, first described, have been used and the work dried, as there described, if the shade should not appear so dark as is wished, let the work be placed before a smart fire, or in bright sunshine, where, however, no current of air passes. When thus exposed, let it be turned occasionally, and brushed with a soft brush. This plan will be found to produce a very fine bronze, after all other have failed, (with the exception of the blacking) but it is tedious, and where time is an object, it will always be found best to use the blacking.

Bronzing Plaster Figures, &c.—When water color is used, the work must be sized over, until it will *bear out*, that is, until the moisture will stand upon the surface, and not sink immediately in. The books in general recommend size made from isinglass, but good, clear, common glue, is much cheaper, and will answer equally well. After the cast or sculpture has been properly sized, it is ready to receive the color; this is prepared by grinding Prussian blue, yellow ochre, and lamp black, in some weak size. The colors ought to be ground separately, and afterwards mixed together, as the Prussian blue requires more grinding than either of the others; and because they may afterwards be so mixed, as to produce any tint required. The color must be spread evenly over the article to be bronzed, and allowed to dry. When it is dry, dip a brush into some thin oil gold size, scrape the brush, so that but little of the size may remain in it, and pass it over the figure, so as just to moisten every part: it is then to be put by until it becomes *tackey*, that is, until the finger will adhere to, but not be moistened by the size; it is then ready to receive the bronze powder.

When gold size is not at hand, a little japan varnish, or even fat oil, diluted with spirits of turpentine, will answer the purpose.

Sometimes the bronze powder is applied without the intervention of any adhesive matter, excepting the size contained in the water color. It must then be rubbed on before the color is perfectly dry.

To Bronze with Oil Color.—First give the work a coat of white, or red lead, ground in oil, and when this is perfectly dry, apply another coat, consisting of the colors before named, ground in oil, and mixed with a small quantity of japan varnish; this is to be suffered to dry, until it becomes tackey, when the bronze powder is to be applied to it,

Bronze Powders.—There are various kinds of bronze powder, which are kept for sale by many of the colormen. The *aurum musivum*, or mosaic gold, is used for inferior articles; this is a preparation of tin, quicksilver, and sulphur, possessing a bright gold-like appearance. A copper colored bronze may be obtained by dissolving copper in aqua-fortis, until it is saturated, and then putting into the solution some small pieces of iron, when the copper will be precipitated in the metallic state, the fluid must than be poured off, and the powder carefully washed, dried, and levigated, when it may be put by for use. Bronze powder is sometimes made from Dutch gold, which is sold in books, at a very low price. This is treated in the same way as gold leaf, in making the gold powder; all these inferior bronzes require to be covered with a coat of clear varnish, or they will very soon lose their metallic appearance, nor will the varnish entirely prevent, although it will greatly retard, this change.

Mode of applying the Bronze Powders.—All the recipes which we have seen, direct the use of a brush, or of a piece of cotton, dipped in the powder; this mode is not only slovenly, but also wasteful, which is of some importance when gold powder is used, and no other material ought ever to be employed, as it greatly excels all its substitutes, both in durability and beauty, and when properly managed, the increased expense is trifling.

The best mode is to cover the finger with a small piece of doe-skin leather; this should be lightly

dipped into the powder, and the loose particles rubbed off upon a piece of fine smooth leather, which may be pasted on a small piece of board, and kept for the purpose; or the cover of a book will answer perfectly well. The powder may then be applied so as to touch those parts only where it is wanted, and then the quantity may be regulated with the greatest exactness. A brush, or a piece of cotton, will allow particles of the powder to fall where it is not desired, and thus injure the work.

We have already said that the prominent parts only ought to be touched with the powder. Some articles, however, admit of more of the metallic covering than others. Thus a medallion, which may be supposed to be frequently handled, and consequently rubbed bright, ought to be covered more freely than a bust, or statue. It is evident that this must be left to the good sense of the workman. Varnish is not only unnecessary, but would materially injure articles, where the genuine gold powder is used.

ARGAND BURNER.

IMPROVEMENT OF, BY SIR J. HERSCHEL.

The following simple, easy and unexpensive mode of greatly increasing the quantity of light yielded by a common Argand burner, has been used by me for some years, and is adapted to the lamp by which I write, to my greatly-increased comfort. It consists in merely elevating the glass chimney, so much above the usual level at which it stands in the burners in ordinary use, that its *lower* edge shall clear the *upper* edge of the circular wick, by a space equal to about the fourth part of the exterior diameter of the wick itself. This may be done to any lamp of the kind, at a cost of about sixpence, by merely adapting to the frame which supports the chimney four pretty stiff wires, bent in such a manner as to form four long upright hooks, in which the lower end of the chimney rests: or still better if the lamp be so originally constructed as to sustain the chimney at the required elevation without such addition, by thin laminæ of brass or iron, having their planes directed to the axis of the wick.

The proper elevation is best determined by trial; and as the limits within which it is confined are very narrow, it would be best secured by a screw motion applied to the socket on which the laminæ above mentioned are fixed, by which they and the chimney may be elevated or depressed at pleasure, without at the same time raising or lowering the wick. Approximately it may be done in an instant, and the experiment is not a little striking and instructive. Take a common Argand lamp, and alternately raise and depress the chimney vertically from the level where it usually rests, to about as far above the wick, with a moderately quick but steady motion. It will be immediately perceived that a vast difference in the amount of light subsists in the different positions of the chimney, but that a very marked and sudden *maximum* occurs at or near the elevation designated in the commencement of this letter: so marked indeed as almost to have the effect of a flash if the motion be quick, or a sudden blaze as if the wick-screw had been raised a turn. The flame contracts somewhat in diameter, lengthens, ceases to give off smoke, and attains a dazzling intensity. With this great increase of light there is certainly not a correspondingly increased consumption of oil.—*Philos. Mag.*

MISCELLANIES.

Luminous Plants.—It is well known that some plants are luminous, and also that parts of plants in an incipient state of decomposition, shine more or less. Potatoes kept in cellars, in a growing state, and therefore useless as food, sometimes become so luminous, that we can read by them the print of a book in the dark. 2. The *Dictamnus albus*, (*Fraxinella*, common in Germany) spreads round it, in dry summer evenings, an atmosphere which, on the approach of a taper, inflames with a blue flame. 3. Other plants give out a *sparkling light*, probably of an electrical nature; such is the case with the flowers of *Calendula*, (Marygold,) *Tropæolum*, (Indian Cress,) *Lilium bulbiferum*, and *Chalcedonicum*, *Tagetes*, (French Marygold,) *Heleanthus*, (Sunflower,) and *Polyanthus*, as mentioned by Mr. Johnson, of Westerby, in Vol. III., p. 145, of the "Edinburgh Philosophical Journal." 4. Some plants give out a calm steady light, as *Dematium violaceum*, *Schistostega osmundacea*, *Phytolacca decandra*, *Rhizomorpha pinnata*, &c. The luminous appearances in the galleries and shafts of our mines are often to be traced to rhizomorphous plants. 5. The milky juice of some plants is very luminous. 6. Trunks, branches, and roots of trees, in an incipient state of decomposition, become luminous.

Joining Tortoiseshell.—The common method of joining tortoiseshell together, is, by making the joint overlap a little; binding a wet linen cloth around it, and pressing the whole between the jaws of a pair of hot tongs. In this way, the effects of heat, moisture, and pressure, are combined in a very convenient manner; and the tortoiseshell is compelled, by their joint action, to become partially dissolved, and to unite firmly.

Fine Blue for Artists, from Indigo.—The blue vat of the dyer contains indigo deoxidised by protoxide of iron, and rendered soluble in its yellow green state by lime-water. If a portion of this solution be exposed to the air in a shallow vessel, the indigo will speedily absorb oxygen, and be precipitated in its usual state of an insoluble blue powder. This being dried and digested, becomes pure indigo, by the abstraction of all the resin and lime contained in it. Thus prepared, it is a fine powder, intensely deep, but softened, tender in its tint, resembling ultramarine, and does not change when exposed to the air; it is, therefore, an acquisition to the palette of no ordinary kind, and is likely to prove the most valuable of all blues, when made into cakes for wash-drawings, for the use of miniature painters.

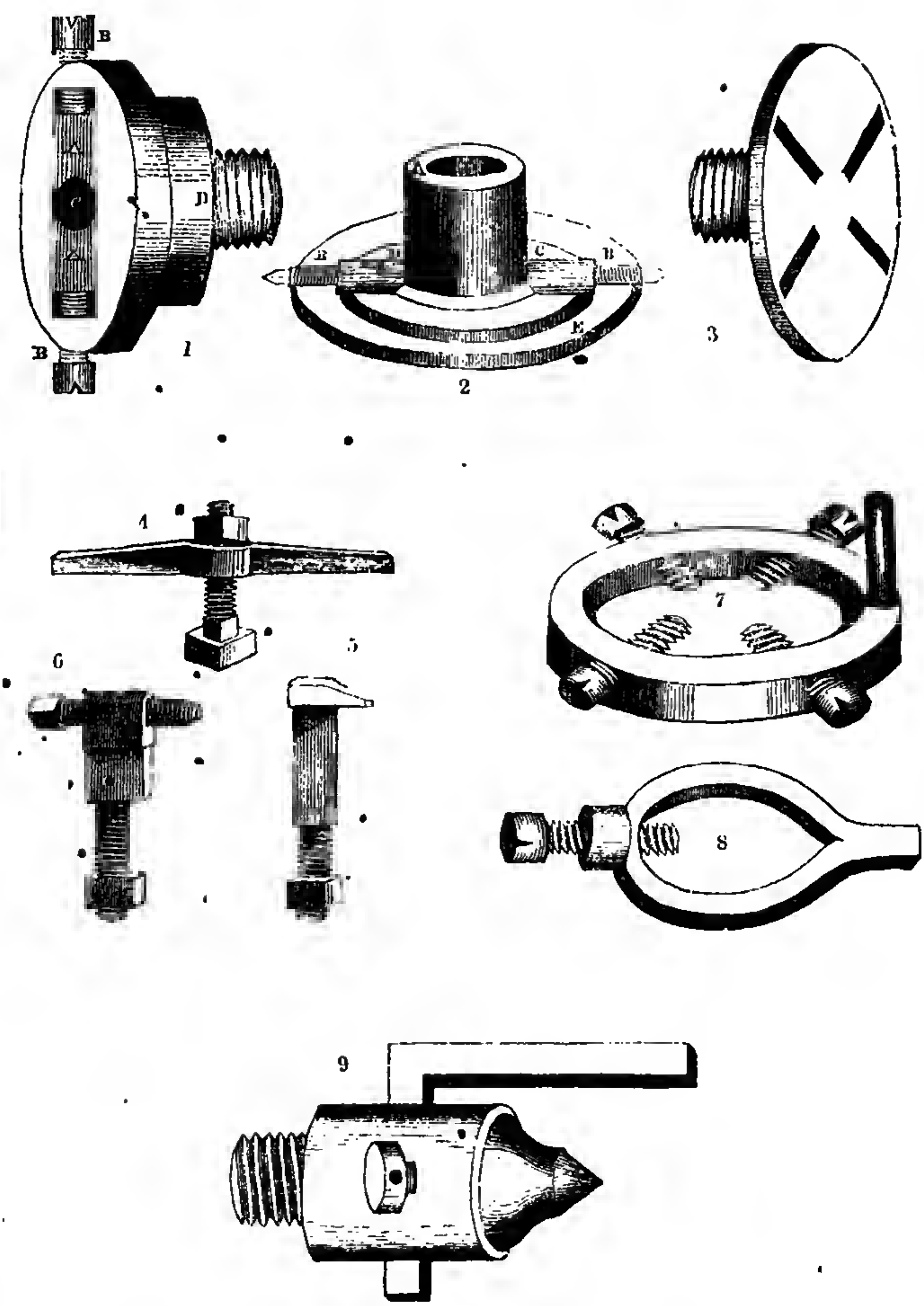
Gold Sheathing for Ships.—The celebrated chemist, Proust, having ascertained that all salt contains a portion of mercury, thought it not unlikely that if a ship's bottom were covered with gold leaf, it might return, after a long voyage, with as much quicksilver adhering to it as would not only pay all expenses, but afford a large profit. The experiment seems deserving of trial.—*Mechanic's Magazine.*

QUERIES.

182—How are stencilled letters or plates made? *Answered on page* 414.

183—What metal is fit for parabolic mirrors? *Answered on page* 414.

184—[illegible] what are the letters on door plates filled, so as to be hard and durable? *Answered on page* 414.



APPENDAGES TO THE LATHE—CHUCKS.

LATHE CHUCKS.

(Resumed from page 347, and concluded.)

The Slide Chuck is made of metal, and is adapted to hold small objects, which it does very firmly, particularly such things as wires, spindles, and others of a like nature. It is represented in Fig. 1, and consists of, first, a screw which fits the mandril of the lathe. The rest of the chuck is pretty solid, and of brass, having a long cavity in the face of it, so constructed as to be wider inside than outside; thus anything fitting into it cannot fall out, although it may slide along from end to end of the cavity; as such slides cannot fall out, it is difficult to conceive how they could get in. This object is attained by making the face of the chuck of a different piece from the back of it, and not screwing it on until the two sliders, marked in the cut A A, have been placed in the cavity C. The two slides may be let out farther from the centre, or brought nearer to it by means of the screws B B. The work to be fixed is placed between the ends of the slides, which it will be perceived are cut hollow that they may hold more firmly.

The Universal Chuck is represented in Fig. 2, and though the screw which fits the mandril is not represented as in the other drawings, yet it is understood to be at A. This part, therefore, is that which fixes it to the lathe, the opposite end of the chuck presenting a hole.. A is a hollow screw, at the bottom of which is another screw B B, which is prevented from moving endwise by a collar in the middle of it. One end of the screw is cut right-handed and the other left-handed, so that by turning it one way, the nuts D C will recede from each other, or by turning it the contrary way they will advance towards each other. These two nuts pass through grooved openings in the plate E, and project beyond it, carrying jaws like those of a vice, by means of which the substance to be turned is held.

The Surface Chuck, as its name implies, is one adapted to turn anything to a flat surface; it is that universally employed by stereotype founders, for turning the back of the plates when cast, and by other artizans, in various of their manufactures. It is figured in No. 3, and consists merely of a flat disc of metal, with four long holes or channels through its face. Its size is considerably wider across than any we have before described, is usually indeed nearly as large as the height of the mandril above the bed of the lathe will allow. In the various grooves are placed certain screws, or dogs, of form and size proportioned to the work to be fixed. The chuck is usually attended with three sets, of the shape represented in Figs. 4, 5, and 6. The appropriate employment of any particular set must, of course, be left to the discretion of the turner. There must be as many in each set as there are channels cut in the face of the chuck.

The Driver Chuck.—This is represented in Fig. 9. It is one of extremely similar construction, and of the greatest utility and general application. It is furnished with the usual screw to fit the lathe head, and is formed merely of a thick piece of iron, pointed at the outer end, and having a square hole made through it, at right angles to its axis. Into this hole fits an elbowed iron bar, about the size represented, and which is moveable in and out the whole, though capable of being fixed in any position by a screw pressing against it. The work to be turned is fastened by one end to the back popit head, and by the other to the point of the chuck. The wood may by possibility be of such a form that the elbowed iron may be made to bear down upon it, and thus turn it round, but this is not always, nor even frequently, the case. When the chuck will not turn it round properly, it is necessary to fasten to the end of the piece of wood what is called a *carrier*, two kinds of which are represented in Figs. 7 and 8,—Fig. 8, for example, being screwed on to the wood, its pointed end will catch against the chuck, and the whole will turn together. This carrier is so simple that a description of it seems unnecessary.

A modification of this apparatus is where the arm of the chuck is straight, and the arm of the carrier bent; thus in Fig. 7, the projecting arm shown would meet a straight arm of the chuck, and, as in the former instance, one would carry round the other.

Besides the above, there are numerous others;—as, for example, *the Branch Chuck*, which has four arms, furnished with screw heads, but it is not useful. *The Boring Chuck* which is nothing but the square hole chuck formerly described, and which has the present name, merely because the usual bits are fixed into it.

The Drill Chuck is precisely the same thing, but adapted for smaller drills. Every turner, indeed, is accustomed to make for himself such chucks as he may require, and most persons will remember some which are not here described. To note them all would be impossible, so many being fashioned for particular purposes, and adapted for holding certain articles; thus the brush-maker, and the seal engraver, require but one—and that to hold his drills or bits; the optician others of particular shape, either for grinding his lenses, or polishing his speculas. The turning of the ivory sliders for magic lanthorns has its own peculiar chuck. The engraver may require one with even tangent screws. The potter, the grinder, the polisher, and the gem cutter use none, though their lathes are fitted up with other apparatus, simple, indeed, but no less necessary for their particular pursuits.

Besides the above, there are other chucks of a compound character, for turning concentric, oval, and other ornamental work; they are known by the names of the *Concentric Chuck*; the *Oval Chuck*; the *Compound Eccentric*; the *Oblique*; the *Geometric*; the *Pillar-Fluting*; the *Spherical*; the *Straight Line*; and the *Epicycloidal.*

We have written an illustrated account of the first, but fear, that without the assistance of other parties, we cannot promise any description of the others, not possessing them, and the whole literature of England, not containing a single work on Turning, except a small production by Ibbetson, sold at an extravagant price, and confined to a description of his own inventions.

LACKERING.

Lackering is a process by which a glossy golden appearance is given to various metallic articles, by means of a more or less pale yellow varnish. Its object is chiefly to prevent such goods from becoming oxidated or tarnished, by exposure to the atmosphere or to water. If made well, lacker is exceedingly durable; and if laid on and burnt with attention and care, adds much to the beauty of the brass or other metal upon which it is laid.

The art of lackering, like all others of a similar character, requires practice to ensure facility

of operating; and the complete success of the operation depends upon a number of minute circumstances, not easy in writing to provide against or to explain. The following remarks and receipts we trust will assist, if not perfect, those who may wish to attain a complete knowledge of the art.

To Prepare Brass Work, &c.—As the object of lackering is not to give a brilliancy, but to preserve one already obtained, it will be evident that in the preparation of any thing, the brighter surface obtained the better. Some goods are turned in the lathe and then polished; sometimes, as in philosophical instruments, burnished also—this makes them sufficiently bright. Other goods, as, for example, many which have chased surfaces, and which cannot therefore be turned with a cutting tool, are held against a *scratch* brush or brush of wire, which is fixed to the lathe like a chuck, and is made to revolve rapidly. This removes all asperities and renders the surface fit to receive the lacker. A third and more common process is after the surface is got by other means as clean as possible, the goods are put into *pickle*, that is, into aquafortis and water, and there suffered to remain some hours, according to circumstances. The acid eats away the outer coat, leaving a bright surface beneath. The goods are now put into bran, and there shaken about to dry and clean them, when they will be ready for lackering.

To Clean Old Work.—Such things as have been lackered before are easily cleaned by boiling them in pearl-ash, when the old lacker will be destroyed, though it will perhaps still lay upon the surface as a whitish kind of varnish. To remove this, and restore the articles to their proper color, let them be soaked in pickle, the same as for new work, examining them from time to time to see if they are sufficiently cleaned.

To lay the Lacker on.—This is done in two ways, called *cold* lackering and *hot* lackering. By the former, a little lacker being taken on the brush, which should be a common camel hair varnish one, it is laid carefully and evenly over the work, which is then placed in an oven or on a hot stove—the heat from this continued only for a minute or two is sufficient to set the lacker, and the work is finished. By the second method, the work is heated first to about the heat of a flat iron as used by the laundress, and the lacker quickly brushed over it in this state, the work being subjected to the oven for a minute afterwards or not, according to the pleasure and judgment of the lackerer. The article, if very small, will require this, because it will have parted with most of its heat in laying on of the lacker; if heavy, it will retain sufficient to perfect the process. The greatest difficulty is to know the exact degree of heat, and this knowledge cannot be attained except by experience, so different is the nature of the materials, the quality of different lackers, and the effect to be produced.

Lacker for Brass.—

2 oz. of amber or copal, ground on porphyry,
40 gr. of dragon's blood,
30 gr. of the watery extract of red sandal wood,
36 gr. of Oriental saffron,
4 oz. of pounded glass, and
40 oz. of very pure alcohol.

To apply this varnish to articles or ornaments of brass, expose them to a gentle heat, and dip them into the varnish. Two or three coatings may be applied in this manner, if necessary. The varnish is durable, and has a beautiful color. Articles varnished in this manner may be cleaned with water and a bit of dry rag.

Lacker for Philosophical Instruments.— This lacker or varnish is destined to change, or to modify the color of those bodies to which it is applied.

¾ oz. of gum guttæ,
2 oz. of gum sandrac,
2 oz. of gum elemi,
1 oz. of dragon's blood, of the best quality,
1 oz. of seed-lac,
¾ oz. of terra merita,
2 gr. of Oriental saffron,
3 oz. of pounded glass, and
20 oz. of pure alcohol.

The tincture of saffron and of terra merita, is first obtained by infusing them in alcohol for twenty-four hours, or exposing them to the heat of the sun in summer. The tincture must be strained through a piece of clean linen cloth, and ought to be strongly squeezed. This tincture is poured over the dragon's blood, the gum elemi, the seed lac, and the gum guttæ, all pounded and mixed with the glass. The varnish is then made according to the directions before given.

It may be applied with great advantage to philosophical instruments: the use of it might be extended also, to various cast or moulded articles with which furniture is ornamented. If the dragon's blood be of the first quality, it may give too high a color; in this case the dose may be lessened at pleasure, as well as that of the other coloring matters.

It is with a similar kind of varnish that the artists of Geneva give a golden orange color to the small nails employed to ornament watch-cases; but they keep the process very secret. A beautiful bright color might be easily communicated to this mixture; but they prefer the orange color, produced by certain compositions, the preparation of which has no relation to that of varnish, and which has been successfully imitated with saline mixtures, in which orpiment is a principal ingredient. The nails are heated before they are immersed in the varnish, and they are then spread out on sheets of dry paper.

Gold-colored Lacker, for Brass-work, Watch-cases, Watch-keys, &c.—

6 oz. of seed lac,
2 oz. of amber,
2 oz. of gum guttæ,
24 gr. of extract of red sandal wood in water
60 gr. of dragon's blood,
36 gr. of Oriental saffron,
4 oz. of pounded glass, and
36 oz. of pure alcohol.

Grind the amber, the seed lac, gum guttæ, and dragon's blood on a piece of porphyry; then mix them with the pounded glass, and add the saffron, after forming with it an infusion of the alcohol and an extract of the sandal wood. The varnish must then be completed as before. The metal articles destined to be covered by this varnish are heated, and those which will admit of it are immersed in packets. The tint of the varnish may be varied, by modifying the doses of the coloring substances.

Lacker of a less drying quality.—

4 oz. of seed lac,
4 oz. of sandarac, or mastic,
½ oz. of dragon's blood,
36 gr. of terra merita,
36 gr. of gum guttæ,
5 oz. of pounded glass,
2 oz. of clear turpentine,
32 oz. of spirits of turpentine.

Extract, by infusion, the tincture of the coloring substances, and then add the resinous bodies according to the directions for compound mastic varnish.

Lacker or varnishes of this kind are called changing, because, when applied to metals, such as copper, brass, or hammered tin, or to wooden boxes and other furniture, they communicate to them a more agreeable color. Besides, by their contact with the common metals, they acquire a lustre which approaches that of the precious metals, and to which, in consequence of peculiar intrinsic qualities or certain laws of convention, a much greater value is attached. It is by means of these changing varnishes, that artists are able to communicate to their leaves of silver and copper, those shining colors observed in foils. This product of industry becomes a source of prosperity to the manufacturers of buttons and works formed with foil, which, in the hands of the jeweller, contributes with so much success to produce the rays of light which doubles the lustre and sparkling quality of precious stones. It is to varnish of this kind that we are indebted for the manufacture of gilt leather, which, taking refuge in England, has given place to that of the papier maché, which is employed for the decoration of palaces, theatres, &c.

In this last place, it is by the effect of a foreign tint obtained from the coloring part of saffron, that the scales of silver disseminated in *confection d' hyacinthe* reflect a beautiful gold color.

The colors transmitted by different coloring substances, require tones suited to the objects for which they are destined. The artist has it in his own power to vary them at pleasure. The addition of annatto to the mixture of dragon's blood, saffron, &c. or some changes in the doses of the mode intended to be made in colors. It is, therefore, impossible to give limited formulæ.

To make Lacker for various Tints.—Mix separately,

1 oz. of gum guttæ in
32 oz. of spirits of turpentine,
1 oz. annatto, and
4 oz. of dragon's blood, also inseparate doses of turpentine.

These infusions may be easily made in the sun. After fifteen days exposure, pour a certain quantity of these liquors into a flask, and by varying the doses different shades of color will be obtained.

They may be employed also for changing alcoholic varnishes; but in this case, the use of saffron, as well as that of red sandal wood, which does not succeed with essence, will soon give the tone necessary for imitating, with other tinctures, the color of gold.

ON ALBUMEN.

Albumen is found of the greatest purity in the white of eggs, being combined only with a minute portion of soda and water. It abounds also in the serum of the blood, the vitreous and crystalline humours of the eye, in the dropsical fluid, the skin, cellular membrane, &c. It is easily dissolved in cold water, but soon passes into putrefaction; when heated, it begins to solidify at 134°, coagulates at 160°, and at 212° shrinks, and dries into a horny mass. When diluted with water it does not so easily coagulate, but when once solidified it becomes entirely insoluble in that menstruum, and can be dissolved only in the pure alkalis potassa and soda. It is coagulated by the acids and metallic oxides, also by the muriates of tin and gold, ferryocyanuret of potassium, acetate of lead, and nitrate of silver; bi-chloride of mercury, however, is the most delicate test of albumen, as water containing only the 1.2000 part of its weight, is rendered turbid by a single drop of a saturated solution of this salt, being converted thereby into calomel, a toxicological fact of great importance. On the addition of concentrated sulphuric acid it becomes black, and exhales a nauseous smell, but if a gentle heat be applied it is re-dissolved, and a solution of a beautiful red color is formed. Strong hydrochloric acid gives it a violet tinge, and at length becomes saturated with ammonia. Nitric acid at 70° disengages a large quantity of azotic gas, and if the heat be increased, hydrocyanic acid is formed. After which carbonic acid and carburetted hydrogen are evolved, and the residue consists of water, containing a little oxalic acid, covered with a light, yellow colored oil. When macerated for a month in dilute nitric acid it is converted into a substance very analagous to gelatine. If dry potass or soda be triturated with albumen, either liquid or solid, ammonical gas is evolved, and the residuum, if calcined, yields a prussiate of the alkali. If mixed with alcohol it separates in the form of white insoluble flocculi.

We will now enter upon the various hypotheses which have been advanced to account for the coagulation of albumen, which was based upon its suppositious imposition, being "free soda, albumen, and water;" and this was inferred to be the case, because soda appeared at the negative, and albumen at the positive pole of a voltaic battery while it was under its influence. Heat is stated to cause coagulation, "by the water abstracting the soda, and leaving the albumen isolated, which is merely stating the effect without the cause. The acids and metallic oxydes are said to decompose it, by uniting with the *alkali*."—How the combination of the oxides and alkali is effected it is rather difficult to conceive; and alcohol precipitates the albumen, by "uniting with the *water*." Here we have two different causes for the same effect. With regard to the neutral salts no explanation has been given in what manner they effect coagulation. It is well known that bichloride of mercury is converted into the proto-chloride when mixed with white of eggs, a fact which so strongly militates against the alkaline theory, that it is impossible to overcome it, for if the alkali is the acting re-agent, binoxide, and not protochloride should have been precipitated. Oxygenation has also been asserted as the cause. Its weak affinity for water has been an hypothesis, whereby almost any re-agent is capable of taking it from it. Dr. Ure, however, attributes it to cohesive attraction, and which, indeed, appears to be the most plausible of any.

Seeing how multifarious and conflicting are the opinions concerning coagulation, it appears pretty evident that we have not yet arrived at a correct estimate respecting the constitution of albumen. It would appear from the effects which electricity produces on it, that it was a compound of a radical and base, but the quantity of soda is so small that we cannot fairly come to this conclusion, especially as the soda is in a free state, which is evident from its action on test paper. Its ultimate elements are as follows:

Carbon	52.883
Hydrogen	7.540
Oxygen	23.872
Nitrogen	15.705
	100.

So that we cannot be surprised at the appearance of the various compounds which arise during its decomposition, seeing it contains every element necessary for their production, but in what manner the elements themselves are arranged in the shape of radical and base, we as yet know nothing, although we cannot but conclude that something of the sort does exist, and that the affinities which they exert for other bodies, is the cause of the various decompositions alluded to. For in the case of the bichloride of mercury, 1 eq. of chlorine must have been abstracted and combined with some other base than soda. This phenomenon of the coagulation of albumen, has so much attracted the attention of philosophers, because it is not found in any other organic body whatever. So, in conclusion, as to the cause of coagulations by *heat*, we can only say, there exists so strong a cohesive attraction among its particles, that very slight causes effect its separation from water, and when heat is applied, the water with the soda in solution expands, till it is beyond the sphere of attraction of the particles of albumen, the attraction of cohesion is then exerted, being no longer opposed by the water and alkali, and it is thus left in an isolated state. When mixed with the *concentrated* alkali it is again dissolved.

ENGRAVING BY VOLTAIC ELECTRICITY.

(Resumed from page 394.)

"*To Procure Fac-similes of Medals, &c.*—This may be done by two different methods; the one, by depositing a *mould* of the voltaic metal on the face of the medal, (having first heated it, and applied wax,) and then depositing the metal (by a subsequent operation) in the mould so formed.

"But the more ready way is, to take two pieces of milled *sheet* lead, (cast lead not being equally soft,) having surfaces perfectly clean and free from indentation. Put the medal between the two pieces of lead, subjecting the whole to pressure in a screw press. A complete mould of both sides is thus formed in the lead, showing the most delicate lines perfect, (in reverse.) Twenty, or even a hundred, of these may be so formed on one sheet of lead, and are deposited by the voltaic process with equal or greater facility; as, the more extensive the apparatus, the more regularly and expeditiously does the operation proceed. Those portions of the surface of the lead, where the moulds do not occur, may be varnished, to neutralize the voltaic action; or, (a whole sheet of copper being deposited,) the voltaic medals may afterwards be cut out.

"A piece of wire must now be soldered neatly to the back of the leaden plate; it is then ready to be put in action.

"*A Voltaic Impression from a Plaster or Clay Model.*—I took two models of an ornament, one made of clay, and the other of plaster of Paris: soaked them for some time in linseed oil; took them out, and suffered them to dry—first getting the oil clean off the surface. When dry, I gave them a thin coat of mastic varnish. When the varnish was as nearly dry as possible—*but not thoroughly so*, I sprinkled some bronze powder on that portion I wished to make a mould of. This powder is principally composed of mercury and sulphur. I had, however, a complete metallic coating on the surface of my model, by which I was enabled to deposit a surface of copper on it, by the voltaic method I have already described. I have also gilt the surface of a clay model with gold leaf, and have been successful in depositing the copper on its surface.

"When the plaster or clay ornament is gilt with gold leaf, or bronzed, a copper wire should be attached to it, by running through from the back, until the point appears above the front surface—or level with it will be sufficient. The other end must then be attached to the binding screw connecting it with the zinc, in all respects similar to any of the foregoing methods.

"*To obtain any number of copies from an already engraved Copper-plate.*—A copper-plate may be taken, engraved in the common manner—the lines being in *intaglio*. Procure an equal-sized piece of sheet lead; lay it on the engraved side of the plate, and put both under a *very powerful* press; when taken out, the lead will have every line, in relief, that had been sunk in the copper.

"A wood engraving may be operated on in like manner;—as lead being pressed into it will not injure it.

"A wire may now be soldered to the lead, then bed it in a box; and put it into the whole voltaic apparatus,—when a copper-plate, being an exact fac-simile of the original, will be formed.

"In this process, care must be taken that the lead is clean and bright, as it comes from the roller in the milling process, and consequently free from any oxidation, which it soon acquires, if exposed to the atmosphere. It should be put in action as soon as possible after being taken out of the press.

"*To Copy a Wood Engraving.*—I may premise that, but for the plasticity and perfectly unelastic property of lead, the discovery would be of but comparatively small value. Plumbers who have handled the substance for the greater portion of their lives, are astonished to find it so susceptible of pressure; on the contrary, wood engravers did not, until now, imagine their blocks would stand the pressure of a screw press on a lead surface without injury; but such is the fact in both instances. In the manner in which box wood is used for wood engravings, being horizontal sections, it will sustain a pressure of 8000 lbs. without injury, provided the pressure is perfectly perpendicular.

"The wood engraving being given, take a piece of sheet lead the requisite size; let its superficies be about one-eighth of an inch larger all round than that of the wooden block. The lead must now be planed with a common plane, just as a piece of soft wood: the tool termed by the joiner the try plane does best;—a clear bright surface is thus obtained, such as I have been unable to get by any other means. The engraved surface of the wood must now be laid on the planed surface of the lead, and both put carefully in the press; should the engraving have more than two inches of superficies, a copying press is not powerful enough. Whatever press is used, the subject to be copied, must be cautiously laid in the centre of the pressure, as a very slight lateral force will in some degree injure the process. The lead to be impressed upon must rest on the iron plate of the press, as must the back part of the wood engraving; the pressure to be applied regularly, and not, as in some cases, with a jerk. When the pressure is deemed complete, they may be taken out; and if, on examination, the lead is not found to be completely up, the wood engraving may be neatly relaid on the lead, and again submitted to the press, using the same precaution as before.

"When the lead is taken out a wire should be soldered to it *immediately*, and put into the apparatus without loss of time, as the less it is subjected to the action of the atmosphere the better;—care should also be taken not to touch the surface with the fingers. In the pamphlet I stated the length of time usually taken to deposit the required thickness of metal;—I have been since able to abridge that period three or four-fold, as I keep the solutions at a temperature of from 120 to 180 Fahrenheit. It has been suggested to me, by Mr. Crosse, of Broomfield, to keep the solutions boiling, which still further increases the rapidity of the deposition. Contrary to the general chemical analogy the deposited metal is of a much superior quality to that deposited by the very slow action of a common temperature.

"At the time it must be borne in mind, that if the process is quickened by strengthening the solution in the positive cell by the addition of an acid, the metal deposited in the opposite one is of a very inferior quality; so much so as to be totally unfit for any practical purpose. Under these circumstances the deoxidating process is not complete, the deposit being a reddish brown protoxide of copper; this last, if let remain for a few days longer, undergoes a still further change, it then becomes a black oxide of copper, such as may be used for organic analysis; and, were I to pursue this branch of chemistry, I should never resort to any other method of obtaining it. The above process will apply to copying engraved copper-plates, or medallions.

"I have also been able to obtain impressions from wood engravings by the following method. Take a piece of tin foil the size, or thereabouts, of the engraving; place it on the engraved surface; over this place a piece of sheet India rubber, and put the whole in a press; on taking out of which it will be found the tin is thoroughly impressed into the lines of the wood. A coating of plaster of Paris must now be laid on the tin to about half an inch in thickness; when set, the whole may be taken off the wooden block. It will be found that the tin adheres to the plaster, and leaves the face of the engraving. The tin surface may now be deposited on to any required thickness. The above was tried on a coarse wood engraving. I am unable to say how it might answer for a fine one.

"I have been more than once reminded of the fusible metal, that melts at a temperature of boiling water, but had no opportunity of trying it; it might be applicable for copying wood engravings.

"*On the Management of the Apparatus.*—Next to electro-magnetism, there is no branch of science that requires more dexterous manipulation than voltaic, or electro-chemistry; the most trifling film of oxidation often retarding the action of the most powerful apparatus. But, in the present instance, slow action, and simplicity of arrangement, being the predominating features, such nice attention to minutiæ is not absolutely necessary,—or at least not so much so as to deter those hitherto unacquainted with the subject from practising.

"In *all* cases, to ensure a metallic connection, binding-screws are preferable to cups of mercury; but, in using them, the copper wire, where the attachment is made, must be brightened with a piece of emery paper,—also the point of the screw, where it presses on the wire. In soldering the wires to the plates, let as little resin be used as possible; sal ammoniac, or dilute muriatic acid, answers the purpose much better.

"In these experiments, I have invariably found an *equal sized* piece of zinc to answer best. In the construction of galvanic batteries in general, I am aware, this is a mooted point with high authority; but my own practice, which has been by no means small, with batteries of every construction, has led me to the opinion that, wherever slow and equable action is required, the positive and negative electrodes should be of equal *superficial* area. Although amalgamated zinc plates are preferable where combined intensity and continuity of action are required, they must not be used, under any circumstances, for the present purposes. It will, likewise, be found to be essential that the *thickness* of the zinc be equal to that of the required deposition.

"Let the porous bottom of the interior vessel, containing the zinc, be a little larger than either of the electrodes. I have hitherto used, for this purpose, either bottomless glass cylinders, or wooden boxes, varnished, with plaster bottoms; but I should recommend a well glazed earthenware vessel, having no bottom, but a slight rim projecting inwards, to secure the plaster. The zinc should be occasionally taken out of the arrangement, during continuance of the process, and cleansed by washing it in water; the saline solution may also be renewed.

"Crystals of sulphate of copper should be added from time to time, to the cupreous solution; but, should the deposition require to be thick, and long-continued, it will be necessary to take out the cupreous solution once or twice during the operation, and add an entirely fresh one,—as the sulphuric acid, necessarily set free after the deoxidisement of the copper, when it predominates to any extent, prevents the required action from taking place on the copper; instead of which, a sub or di-oxide of copper is deposited, in the form of a reddish brown powder—the solution being rendered colorless. When this takes place, the plate should be taken out, and well washed in very dilute nitric acid. I have tried several methods to take up the sulphuric acid as it was set free; pure clay answers this purpose pretty well, the acid combining to a certain extent with it, and forming a sulphate of alumina, or alum, at the bottom of the vessel.

"When the voltaic copper is bent, it breaks at a similar angle to cast copper; but when heated to a red heat, and slowly cooled, it assumes somewhat of the pliability of rolled sheet copper, requiring to be bent several times before breaking; should it now be beaten on an anvil, it will resume its brittleness.

"It may be filed, polished, and cut with shears, in the usual manner—the surface acquiring as fine a polish as the copper in use among engravers.

"Should a thick mass of metal be requisite for any practical purpose; as it would require a considerable lapse of time before it could be obtained by the voltaic process, the back of the deposited metal may be thickened or filled up with solder, in a manner already practised in the arts, without the slightest injury to the surface or texture of the deposited metal.

(Concluded on page 411.

REVIEW.

The Sidereal Heavens, and other Subjects connected with Astronomy. 584 *Pages and numerous Plates.* Ward & Co. Paternoster Row.

One of the very best and cheapest books of the season. Of solid scientific character, of clear and elegant style, of convincing and judicious argument

elegant style, of convincing and judicious argument, of careful arrangement, and of that firm principle which all who are well disposed so love to contemplate. The Author, Thomas Dick, L.L.D., is already favorably known to the public as the author of that widely extended work, entitled "Celestial Scenery." The present is in the same style; and, if possible, of yet greater excellence. To quote from such a work, that is, to select passages is extremely difficult, for having chosen one passage we are, on further reading, apt to desire to introduce more than enough, each one appearing better than the former. The Publisher, too, has got up the work with much care, taste, and expense, so that it is fit for the drawing-room, as well as the library. We give the following passage as an example, to show the style and mode of reasoning which pervades the whole:—

"This earth, and all the huge planets, satellites, and comets, comprised within the range of the solar system, bear a very small proportion to that splendid luminary which enlightens our day. The SUN is five hundred times larger than the whole, and would contain within its vast circumference thirteen hundred thousand globes as large as our world, and more than sixty millions of globes of the size of the moon. To contemplate all the variety of scenery on the surface of this luminary would require more than fifty-five thousand years, although a landscape of five thousand square miles in extent were to pass before our eyes every hour. Of a globe of such dimensions, the most vigorous imagination, after its boldest and most extensive excursions, can form no adequate conception. It appears a kind of universe in itself; and ten thousands of years would be requisite before human beings, with their present faculties, could thoroughly investigate and explore its vast dimensions and its hidden wonders.

"But great as the sun and his surrounding planets are, they dwindle into a point when we wing our flight towards the starry firmament. Before we could arrive at the nearest object in this firmament, we behoved to pass over a space of at least twenty billions of miles in extent,—a space which a cannon ball, flying with its utmost velocity, would not pass over in less than four millions of years. Here every eye in a clear winter's night may behold about a thousand shining orbs, most of them emitting their splendours from spaces immeasurably distant; and bodies at such distances must necessarily be of immense magnitude. There is reason to believe that the least twinkling star which our eye can discern, is not less than the sun in magnitude and in splendour, and that many of them are even a hundred or a thousand times superior in magnitude to that stupendous luminary. But bodies of such amazing size and splendour cannot be supposed to have been created in vain, or merely to diffuse a useless lustre over the wilds of immensity. Such an idea would be utterly inconsistent with the perfections of the Divinity, and all that we know of his character from the revelations of his word. If this earth would have been '*created* in vain,' had it not been inhabited, so those starry orbs, or, in other words, those magnificent suns would likewise have been created in vain, if retinues of worlds and myriads of intelligent beings were not irradiated and cheered by their benign influence.

"These thousand stars, then, which the unassisted eye can perceive in the canopy of heaven, may be considered as connected with at least *fifty thousand worlds;* compared with the amount of whose population all the inhabitants of our globe would appear only as 'the small dust of the balance.' Here the imagination might expatiate for ages of ages in surveying this portion of the Creator's kingdom, and be lost in contemplation and wonder at the vast extent, the magnitude, the magnificence, and the immense variety of scenes, objects, and movements which would meet the view in every direction; for here we have presented to the mental eye, not only single suns and single systems, such as that to which we belong, but suns revolving around suns, and systems around systems,—systems not only double, but treble, quadruple, and multiple, all in complicated but harmonious motion, performing motions more rapid than the swiftest planets in our system, though some of them move a hundred thousand miles every hour, — finishing periods of revolution, some in thirty, some in three hundred, and some in one thousand six hundred years. We behold suns of a blue or green lustre revolving around suns of a white or ruddy color, and both of them illuminating with contrasted colored light the same assemblage of worlds. And if the various orders of intelligence connected with these systems were unveiled, what a scene of grandeur, magnificence, variety, diversity of intellect, and of wonder and astonishment, would burst upon the view! Here we might be apt to imagine that the whole glories of the Creator's empire have been disclosed, and that we had now a prospect of universal nature in all its extent and grandeur.

"But although we should have surveyed the whole of this magnificent scene, we should still find ourselves standing only on the outskirts, or the extreme verge of creation. What if all the stars which the unassisted eye can discern be only a few scattered orbs on the outskirts of a cluster immensely more numerous? What if all this scene of grandeur be only as a small lucid speck compared with the whole extent of the firmament? There is demonstrative evidence from observation that this is in reality the case. In one lucid circle in the heavens, scarcely perceptible on a cursory view of the firmament, there are twenty thousand times more stars distinguishable by the telescope than what the naked eye can discern throughout the visible canopy of heaven. The milky way, were it supposed to contain the same number of stars throughout its whole extent, as have been observed in certain portions of it, would comprise no less than 20,191,000 stars; and as each of these stars is doubtless a sun, if we suppose only fifty planets or worlds connected with each, we shall have no less than 100,955,000, or more than *a hundred millions* of worlds contained within the space occupied by this lucid zone. Here an idea is presented which completely overpowers the human faculties, and at which the boldest imagination must shrink back at any attempts to form an approximate conception. A hundred millions of worlds! We may state such a fact in numbers or in words, but the brightest and most expansive human intellect must utterly fail in grasping all that is comprehended in this mighty idea; and perhaps intelligences possessed of powers far superior to those of man, are inadequate to form even an approximate conception of such a stupendous scene. Yet this scene, magnificent and overpowering as it is *to* limited minds such as ours, is not the scene of *the* universe, it is only a comparatively insignificant speck in the map of creation, which beings at remote distances may be unable to detect in the canopy of their sky,

or at most will discern it only as an obscure point in the furthest extremities of their view, as we distinguish a faint nebulous star through our best telescopes.

"Ascending from the milky way to the still remoter regions of space, we perceive several thousands of dim specks of light which powerful telescopes resolve into immense clusters of stars. These *nebulæ*, as they are called, may be considered as so many milky ways, and some of them are supposed even 'to outvie our milky way in grandeur.' Above three thousand of these nebulæ have been discovered; and if only two thousand be supposed to be resolvable into starry groups, and to be as rich in stars at an average as our milky way, then we are presented with a scene which comprises 2000 times 20,191,000, or 40,382,000,000, that is, more than *forty thousand millions* of stars. And if we suppose, as formerly, five planetary globes to be connected with each, we have exhibited before us a prospect which includes 2,019,100,000,000, or two billions, nineteen thousand one hundred millions of worlds. Of such a *number* of bodies we can form no distinct conceptions, and much less can we form even a rude or approximate idea of the *grandeur* and *magnificence* which the whole of such a scene must display. Were we to suppose each of these bodies to pass in review before us *every minute*, it would require more than three millions, eight hundred and forty thousand years of unremitting observation before the whole could be contemplated even in this rapid manner. Were an hour's contemplation allotted to each, it would require two hundred and thirty millions, four hundred thousand years, till all the series passed under review; and were we to suppose an intelligent being to remain fifty years in each world, for the purpose of taking a more minute survey of its peculiar scenery and decorations, 100,955,000,000,000, or a hundred billions, nine hundred and fifty-five thousand millions of years would elapse before such a survey could be completed; a number of years which to limited minds seems to approximate to something like eternity itself"

MISCELLANIES.

Composition of the Atmosphere.—M. A. Chevallier states the following as the results of his researches on the composition of the atmosphere:—1st. In general, the air of Paris and of many other places contains and organic matters in solution.—2nd. If the water deposited from air (dew) by cooling be examined, it is found to contain ammonia and organic matters. 3rd. The quantity of ammonia contained in the air is often pretty considerable.—4th. The presence of ammonia is easily explained, because this gas is produced under many circumstances. 5th. The composition of atmospheric air may vary in certain localities, from a great number of particular circumstances, as the nature of the combustible employed in great masses, the decomposition of animal and vegetable matters, &c. &c. The air of London contains sulphurous acid, that of the sewers of Paris contains acetate and hydrosulphuret of ammonia; air taken near the *bassins* de Montfauçon contains ammonia and its hydrosulphuret.—*Journal de Pharmacie.*

Æthereal Oil of Wine.—It is well known that a mixture of alcohol and water in the same proportions as they exist in wine has scarcely an odour, whilst a few drops of wine remaining in a bottle will be easily recognised by its smell. This characteristic odour, which is possessed by all wines in a greater or less degree, is produced by a peculiar substance, which has all the characters of an essential oil. This substance is not to be confounded with the aroma of wine; for it is not volatile, and appears to be different in various kinds of wine, and in the greater number it does not exist at all. When large quantities of wine are submitted to distillation, an oily substance is obtained towards the end of the operation; it is also procured from wine lees, and especially from that which is deposited in the casks after fermentation has commenced.

This æthereal oil forms about one 40,000dth part of wine. In its original state it has a strong flavor, is usually colorless, but owing to the presence of a small portion of oxyde of copper, it is sometimes greenish: when this is separated by hydrosulphuric acid it is colorless. The mode of purifying this substance will be mentioned after its composition and principal properties have been described.

This æthereal oil of wine contains a considerable quantity of oxygen; but its constitution is very different from that of the oxygenated essential oils hitherto known. It consists of a new peculiar acid, analagous to the fatty acids, combined with æther; and it of course is one of the class of compound æthers. It is the first instance of the occurrence of an æther which is insoluble in water, and produced during the vinous fermentation without the intervention of the chemist. The strong resemblance which this substance bears to the essential oils, ought to cause them to be studied under the same point of view, and it is probable that light may be thrown thereby upon this class of organic compounds. To the new acid MM. Liebig and Pelouse have given the name of *œnanthic acid*, and to the essential oil *œnanthic æther.*—*Philos. Mag.*

Receipt for Purple Fire.—Reduce each of the following ingredients separately to a fine powder; mix them by stirring carefully; and rub them through a hair sieve. The mixture will, when made into rocket stars, and inflamed, burn with a fine purple light:—

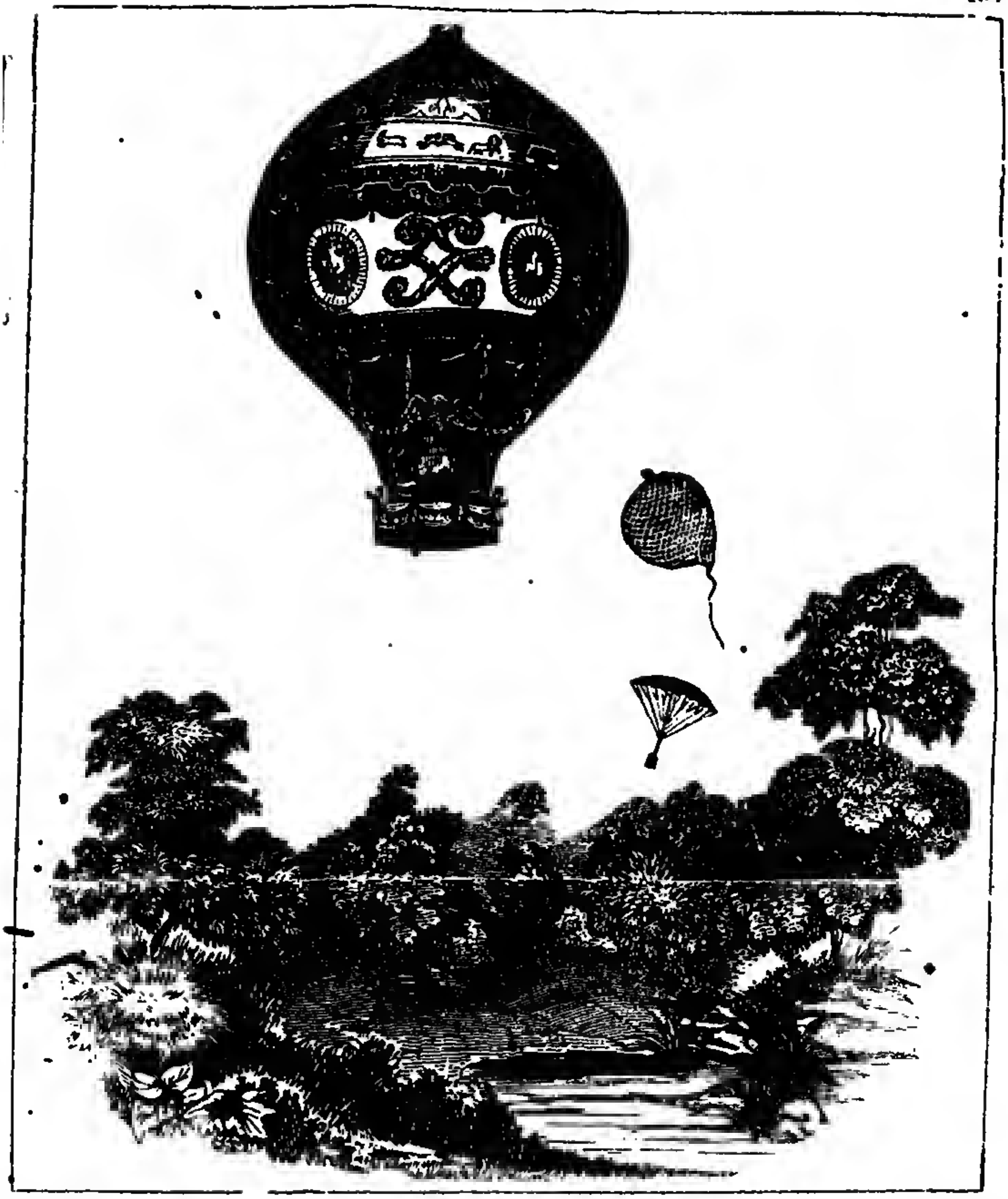
Chlorate of potash	. . .	2 oz.
Black oxyde of copper	. .	1 oz.
Sulphur	. . . .	1 oz.

Receipt for Green Fire.—Mix, as above directed, the following ingredients; which, when burnt, produces a green flame:—

Dry nitrate of barytes	. .	1½ lb.
Chlorate of potash	. . .	4 oz.
Relagar, or still better Metallic arsenic	. . .	2 oz.
Charcoal	. . . . . .	1¼ oz.
Sulphur	. . . . . .	8 oz.

Receipts for Red and Blue Fire, *(see page 328.)*

Tortoiseshell Boxes.—Horn and tortoiseshell boxes are thus formed:—These substances being placed in brass moulds, and subjected to the action of strong screw-presses, which are placed in boilers; and, when heated, the screws being turned, compel these softened substances to unite firmly together, and to receive the forms given to them by the moulds. A glue, which may assist in their union, can also be made of the raspings of tortoiseshell; by exposing them in close vessels, with a little water, to the action of heat, under pressure, in the manner of a Papin's digester.



The balloon constructed by the brothers Montgolfier, and as has before been alluded to as the first aeronautic machine, of sufficient buoyancy to carry any considerable weight into the air, was totally different, not merely in principle, but appearance, from those at present in use. Now, as is well known, a balloon is but a globular silk bag, with a boat-shaped basket, or car, attached to a net-work of ropes which passes over it. That made by Montgolfier, and first used by M. de Rosier, was decorated with much trouble and expense, and composed of silk, partly covered with gold, spangles, and scarlet velvet. The lower part, or car, was a gallery sufficiently large for the aeronaut to walk round, the centre being hollow, and holding the iron frame-work, in which the fire was placed. The introductory cut shows the pattern and ornamental character of Montgolfier's balloon.

At the same period that the original discoverers of aerostation were thus astonishing the whole people of France, attempts were made by others, particularly by Messrs. Charles and Roberts, to achieve something equally interesting, though upon the same subject.

The levity of hydrogen gas had been already discovered, and Mr. Charles was desirous of employing it to inflate a balloon. His attempts were at first much ridiculed, and he was upbraided for endeavouring to discover any other principle than that already made. Undeterred, however, by such discouraging circumstances he shortly was enabled to prove the truth of his imaginings, *for*, on the 1st of December, 1783, he, with *Mr.* Roberts, ascended from the Tuilleries, made a most successful voyage, and descended *in* perfect safety.

Various ascents with the rival balloons were about the same time made in different countries of Europe, by Montgolfier, Andræani, Fleurant and Madam Thible, Rosier and Proust, Guyton, Morveau, L'Abbé, Bertrand and Yestu, in France. Abbe Carmus, in Rhodes. Lunardi and Blanchard, in England. Lunardi ascended from the Artillery Ground, London, on the 21st of September, 1784, amid a concourse of many thousands of spectators. He afterwards repeated the experiment in different parts of England, and during the following year in Scotland. This active person took an expeditious but careless way of filling his balloon, which was one upon the hydrogen principle. He had two large casks sunk into the ground for their better security, in which he deposited 2000 pounds of the borings of cannon, divided by layers of straw, to present a larger surface; an equal quantity of sulphuric acid, or oil of vitriol, diluted with six times its quantity of water, was poured upon the iron, and the hydrogen gas, now formed, without being cooled or washed, was immediately introduced into the balloon.

To Lunardi succeeded Blanchard, who performed not fewer than 36 voyages through the air, and acquired a large sum of money for his exhibitions. His most remarkable voyage was across the British Channel, in company with Dr. Jefferies, an American gentleman, on the 7th of January, 1785, in a clear frosty day; his balloon was launched from the cliffs of Dover, and after a perilous course of two hours and three quarters, arrived in safety on the edge of a forest near Calais.

All these ascents had been hitherto conducted with the most perfect safety, though some of them, besides that of Blanchard, not without danger. But soon afterwards, namely, on the 15th of June, 1785, the enterprising Rosier, and his friend Romain, after ascending to a height of above 3000 feet, were precipitated to the ground and dashed to pieces, in consequence of their balloon catching fire. It consisted of a large silk bag, filled with hydrogen, and with a smaller fire balloon attached—a spark from which occasioned the catastrophe.

Among the greatest dangers to which æronauts are exposed is that of a too rapid and premature descent. To guard in some degree against the risks arising from the occurrence of such accidents, the parachute was afterwards introduced, being intended to enable the voyager, in case of alarm, to desert his balloon in mid-air and drop, without sustaining injury, to the ground. Blanchard was the first who constructed parachutes, and attached them to balloons, for the sake of effecting his escape in case of accident. During the excursion which he undertook from Lisle, about the end of August, 1785, when this adventurous æronaut traversed, without halting, not less than 300 miles, he let down a dog from a vast height in the basket of a parachute, and the poor animal falling gently through the air, reached the ground unhurt.

Since that period the practice and management of the parachute have been carried much farther by other aerial travellers, and particularly by M. Garnerin, who repeatedly descended by that machine from the region of the clouds.

This ingenious and spirited Frenchman visited London during the short peace of 1802, and made two fine ascents with his balloon, in the second of which he threw himself from an amazing elevation with a parachute. This consisted of 32 gores of white canvas, formed like an umbrella covering, of 23 feet diameter, at the top of which was a round piece of wood, 10 inches broad, and having a hole in its centre, admitting short pieces of tape to fasten it to the several gores of the canvas. About 4 feet and a half below the top was a hoop of 8 feet diameter, attached by a string from each seam, so that when the balloon rose the parachute hung like a curtain from this hoop; below it was suspended a cylindrical basket, covered with canvas, about 4 feet high and two and a quarter wide. In this basket the æronaut placed himself, and rose majestically from an inclosure, near North Audley Street, at 6 o' clock in the evening of the 2nd of September. After hovering 7 or 8 minutes in the upper regions of the air, he cut the cord which attached the balloon to the parachute;—it instantly expanded—vibrated to and fro with violence—passed over Marylebone and Somers Town, and descended in a field in St. Pancras. The shock, however, was so violent, that Garnerin was thrown on his face and somewhat hurt.

Since the above period, ærostation has not given rise to any material novelties worth relating, though hundreds of ascents have since been made; indeed, ballooning is a popular amusement, and æronauts employ their experience as a means of private gain and public exhibition. The names of Graham, Sadler, Harris, and others, are well known, and the fate of poor Mr. Cocking will be long remembered. Mr. Green also deserves particular notice for his celebrated trip in the "Monster Balloon," with which he travelled from London to Nassau, and which he is now endeavouring to adapt for a passage to America. This great and bold enterprize he hopes to accomplish by attaching wings to his balloon, to guide it in its course; the annexed extract explains what is at present known upon the subject, and is the last improvement science and ingenuity has accomplished in favor of ærostation.

"*Novel Experiment in Ærostation.*—A series of very interesting experiments was privately exhibited in the lecture room of the Polytechnic Institution, in Regent Street, on Tuesday afternoon, by Mr. Green. That celebrated æronaut has long entertained the opinion that a balloon voyage from the continent of America to Europe may be safely and certainly effected, founded on repeated observations in the atmosphere, which have led him to the conviction that, whatever may be the direction of the winds below, the current of air above invariably traverses from some point between the north and west. Mr. Green has kept a regular log of all his numerous voyages, and in no instance, (we are informed,) has a single exception to this rule been encountered. To get into, and remain in, this current it is, however, necessary that the balloon should be kept at a certain altitude; and to show how this could be effected was one of the objects of the experiments. The machinery made use of by Mr. Green is both simple and portable, and is constructed upon a well-known pneumatic principle. It is composed of two fans, or blades of wood, attached to a spindle, which passes through the bottom of the car. The fans are of one longitudinal piece, to the centre of which the spindle is fixed, after the manner of a windmill, with but two wings or arms, and their blades present a given angle horizontally, in which direction they move. The effect, as we witnessed it, was as follows:—

"A miniature balloon, of about three feet diameter, was filled with common coal gas. To this were attached the hoop, netting, and car, and

in the car a small piece of spring mechanism was placed, to give motion to the fans. The balloon was then balanced; that is, a sufficient weight was placed in the car to keep it suspended in the air, without the capacity to rise or inclination to sink. Mr. Green then touched a stop in the mechanism, which immediately communicated a rapid rotary motion to the fans, whereupon the machine rose steadily to the ceiling, from which it continued to rebound until the clock work had run out. Deprived of this assistance, it immediately fell. The reverse of this experiment was then performed. The balloon was first raised into the air, and then balanced. A similar motion was imparted to the fans, the action of which in this case was, however, reversed, and the balloon was immediately pulled down to the ground by their forces. A more interesting effect still was then exhibited. The balloon, with the guide rope attached to it, was balanced as before, the guide rope having a small brass weight fixed to the end of it. The fans were then removed from under the car and placed sideways upon it, by which their action became vertical. Upon motion being communicated, the balloon floated in a horizontal line, dragging the guide rope after it with the weight trailing along the floor, and continued to do so until the mechanism ceased, when it immediately become stationary again. These experiments were frequently repeated with complete success. Mr. Green states, that by these simple means, a voyage across the Atlantic may be performed as easily as one from Vauxhall Gardens to Nassau, and he calculated that from three to four days will be sufficient for the undertaking. *Nous verrons.* Meanwhile, we must do Mr. Green the justice to say, that his experiments were grafted upon sound scientific knowledge. We know he contemplates no such absurdity as impelling a balloon against the wind, which is an impossibility. All he desires is to gain a point or two, if need be, in the direction which he is going, and to maintain himself at a certain altitude by extraneous assistance. The required size of the fans for his "Monster" balloon would be about six feet in length, and the machinery by which they would be turned would be placed inside the car, to be governed at the will of the persons there. These experiments will probably be practically carried out during the summer, when the public will have a fair opportunity of judging how far they are capable of securing safe transit over four thousand miles of ocean, which appears to us to be, under any circumstances, a most perilous undertaking."—*The Times.*

TRANSFERRING OLD PAINTINGS TO NEW CANVAS.

The art of removing paintings from the cloth or wood on which they are originally done, and transferring them to new grounds of either kind.

For those on cloth or canvas, the method is as follows:—Let the decayed picture be cleansed of all grease that may be on its surface, by rubbing it very gently with crum of stale bread, and then wiping it with a very soft linen cloth. It must then be laid with the face downwards on a smooth table, covered with fan paper, or the Indian paper; and the cloth on the reverse must be well soaked with boiling water spread upon it with a sponge until it is soft and pliable. Turn the picture with the face upwards and stretch it evenly on the table; pin it down with nails at the edges.

Having melted a quantity of glue, and strained it through a flannel cloth, spread part of it, when a little stiffened, on a linen cloth of the size of the painting; and when this is set and dry, lay another coat over it—when this has become stiff, spread some of the glue, moderately heated, over the face of the picture, and lay over it the linen cloth already prepared in the most even manner, and nail it down to the picture and table. Then expose the whole to the heat of the sun, where it may be secure from rain, till the glue is dry and hard—then remove it from the table. Turn the picture with face downwards—let it be nailed as before; raise round its edges a border of wax, forming a kind of shallow trough with the surface of the picture, into which pour a corroding fluid, as oil of vitriol, or spirits of salts, (the last is to be preferred;) diluted to such a degree, determined by previous trials, that it may destroy the thread of the canvas without discoloring it. When it has answered the purpose, drain it off through a passage made in the wax border, and wash by repeatedly pouring fresh water on the cloth; the threads of the cloth must then be carefully picked out, till the whole be taken away, being thus freed from the cloth, must be well washed with water and sponge, and left to dry.

In the meantime prepare a new piece of canvas, and having spread some hot glue, melted with a little brandy or spirits of wine, over the reverse of the painting, lay the new canvas while the glue is hot, and compress them together with plates of lead, or marble. When the glue is set, remove the weights, let the cloth remain till the glue has become hard and dry, then the whole must be again turned, and the border of wax replaced; the linen cloth must be destroyed as before; the painting must then be freed from the glue by washing it with hot water and a sponge. The painting may then be varnished, and if the process has been well conducted, it will be transferred in a perfect state.

When the painting is on wood it must be done in the same way, with this exception, that after the face has been covered with the linen cloth, in the preceding process, it must be laid on a blanket several times folded, and the wood planed away as thin as possible, not to touch the paint. The process is afterwards the same as before.

J. GR—.

ENGRAVING BY VOLTAIC ELECTRICITY.

(Resumed from page 407, and concluded)

The former papers communicate all that the original writer, Mr. Spencer, has handed down in various publications on this interesting subject. The next remarks are by Mr. Sturgeon, as given in his "Annals of Electricity;" they will, perhaps, afford hints to the experimentalist, which may assist in the further application of the subject.

My dear Sir.—In our conversation, on the subject of taking fac-simile impressions, in copper, of medallions, coins, &c., by the process of voltaism, you will remember that the idea occurred to me of giving them silver or golden surfaces, by a similar voltaic process; employing a solution of either of those metals in connection with the *prepared* matrix, instead of a solution of copper. Turning the

subject over in my mind whilst walking home, a thought struck me that a *complete* medallion of any kind of metal might easily be made by the voltaic process; or the medallion might be constructed of different metals and in a variety of ways, which it would be found difficult to imitate by any other process.

"The following are some of the methods :—

"Let a matrix of each side of the medallion, intended to be copied, be made in the usual way, by means of the alloy usually called *Newton's fusible metal;* and let the metal be about an eighth of an inch in thickness. To the back of this metal is to be soldered one end of a copper wire, and to the other end a piece of zinc, which is afterwards to be amalgamated. The metal in which the matrix is formed is now to be covered with a thin stratum of either varnish or wax, leaving bare the matrix only. The wire is also to be covered in a similar manner, and is to be bent so as to adapt the voltaic metals to their respective positions in the vessels holding the liquids employed. In a few hours the matrix will have received a coating of precipitated metal from the solution, which may be either gold or silver; the thickness of the coating will depend upon the time. When this coating is supposed to be of sufficient thickness, remove the solution of the silver or the gold, as the case may be, and replace it by a solution of the sulphate of copper, and, in the course of a few days, you will have a considerable thickness of copper precipitated on the silver coating on the matrix. These two metals will adhere firmly together so as to be one piece. When this young semi-medallion is removed from the matrix, it will have a copper body with a silver or a gold face.—Its twin-sister may be formed by proceeding in the same way, with the matrix formed from the opposite face of the original medallion, and, when the process is completed, the flat copper sides may be soldered neatly together, so as to form a complete medallion similar to the original one.

"By a similar process a complete medallion may be formed, having a gold surface on one side and a silver one on the other.

"Another beautiful variation may be made by the following process. Imagine that we wanted a medallion whose *prominent* parts should be of gold, and the rest silver. The head of Newton, for instance, with its motto, to be gold. Varnish with wax every other part of the matrix, and put it in galvanic action in a solution of gold. In a few hours a golden head and motto will be formed. Now remove the gold solution; and clean the matrix of its coating of wax. Now put the matrix in voltaic action in a solution of silver, and the face of the new medallion will be filled up with silver. If the body of the medallion is to be silver, the action may be continued for a few days; but if the body is to be of copper, proceed, as before directed, with a solution of sulphate of copper. Similar processes give infinite scope to the ingenious in varying and ornamenting this scale of voltaic productions."

W. STURGEON.

We will now venture to offer a few remarks.—First, as to the solutions used. Sulphate of copper in a saturated state is essential; the solution in contact with the zinc is immaterial; salt and water is very good, but water with a few drops of sulphuric acid is still better; but not, however, so much acid as Mr. Spencer recommends, for then the chemical action is too great, and the zinc is wasted.

It is not necessary to apply clay or anything else to the solution of copper, under the impression that the sulphuric acid is in excess; for it will be found, that as fast as the copper is deposited, the acid is drawn away from the solution through the diaphrem to the zinc, and that keeps up the action. This may be experimentally proved; for, although the solution becomes colorless, yet it is not acid to the taste.

Next, as to the material to form the division between the two electrodes, or poles. Plaster of Paris will, as Mr. Spencer says, answer very well; but still better if mixed up with equal proportions of powdered Bath brick, which renders it more porous. A common small garden pot will do, a cork being inserted into the bottom of it. What is far better is a roll of brown peper two or three times doubled, and to keep it tight tied at top and bottom. Such a tube may be made by rolling brown paper round a ruler, tying it at the top, and covering the bottom over with three or four folds of the same, tying that part also. A tube such as this will answer for all kinds of pot batteries. The size and shape of the piece of zinc used is not very material; a rod of zinc and plate of copper will do as well as if they were of the same shape and size.

Moulds, Mr. Spencer says, should be of lead;—these we have tried: they will answer; but are infinitely inferior to those made of fusible metal. But there is a very great difficulty in casting the moulds. The best method of accomplishing it, that we know of, is as follows:—

Premising that the alloy to be used is made of five parts of bismuth, three lead, and two tin, melted together. When in a state just melted, pour a sufficient quantity of it upon a piece of paper, placed upon the hearth-stone; let the medal which you desire to mould be quite cold; and when the fluid alloy is nearly ready to set, dash the medal down upon it, with an even but considerable force, like a light blow. The alloy, if in a right state, will exhibit a most perfect and sharp impression of the coin or medal. This process, simple as it may appear in writing, is attended with some difficulty; and if the tyro succeed once in four or five times, he may think himself fortunate.

We now conclude this subject—not that it is exhausted, but because space does not allow a greater extension of it.

CANKER IN TREES.

VARIOUS are the causes said to bring on this desolating disease. Bad or wet soil and subsoil;—exposure to cold bleak winds, in high situations particularly; stricture of the bark; frost in spring, checking the circulation of the sap; external injuries of different kinds; insects lodgings in the cracks, and under the old bark; the infirmities of decrepit old age in those varieties long cultivated in Britain;—improper stocks, or improper grafting. Though others seem to be of a different opinion, yet Mr. Knight thinks that no tropical application will do any good, and that the disease is not of the bark but of the wood: and I am inclined to believe that this may frequently be the case; for, on removing cankered branches, I have often remarked that the very heart was infected and discolored, and the wood under all the three different barks rotten or diseased. And that it often proceeds from the infirmities of decrepit old age, in those varieties long cultivated in this island, I am also convinced, from its being so very destructive to young trees in new gardens, in many of which it is very prevalent, where these old kinds are found.—*Mem. Caled. Hor. Soc.*

ANSWERS TO QUERIES.

47—*What is the cause of Elasticity?* Elasticity is one of the properties of matter, inherent in certain substances, but the cause of it is no more known to us than is the cause of weight, hardness, or malleability. It is easy to form hypotheses to explain all these matters, and to say that elasticity arises from the particles of bodies, although tenaciously united together, having for each other a certain repulsive force, which is exerted to restore them to their first form, when any force which has compressed them is removed—or we may say that elasticity is inherent in those bodies which are composed of hollow atoms, but either explanation is unsatisfactory and without proof.

62—*How is Indian-Rubber Moulded into Shoes?* A mould of proper shape is attached to the tree from which the Indian-rubber exudes; this flows over the mould and forms the shoe—or else the liquid Indian-rubber is rubbed over the proper lasts. [Such is the explanation given to the Editor by Mr. Macintosh.]

65—*How are Medallion Wafers to be made?* Color Salisbury glue by means of Brazil wood, turmeric, or the like; fill up the hollow part of a seal with any colored powder (white is the best,) made into a paste with thick gum water, having the flat part clear; then pour as much of the melted colored glue on the seal as will lie upon it, and let it dry in a gentle heat; when used, wet the paper where the wafer is to be applied, and place the back of the wafer on the wet paper.

86—*Why are Eggs coagulated when boiled, and unable afterwards to resume their fluid state?* See Albumen, page 404.

98—*What is the cause of the Rotatory Motion of a Watch Glass sliding down a Table?* There is no cause for a nonentity; it is not a fact that it does rotate.

124—*What is the construction of the Eccentric Chuck?* It is a chuck which has a groove and sliding piece across it, as well as the adaptation of moving round, by which means the centre of the work appended to it may be made to turn round any required centre. A fuller description of, and specimens of work done by it, will be inserted in the next volume.

127, 128—*What is the result of Medicated Earths on the Coloration of Flowers? also, Is it possible to produce a blue and scented Dahlia?* Considering that the water which the roots of plants absorb is impregnated with various salts and animal matters it might be supposed that these would affect their color, as well as their luxuriance of growth; but such is not found to be the case. Mr. Knight, we believe, tried numerous experiments on this subject, but without success; and modern gardeners have, of late years, been extremely anxious to procure dahlias scented like primroses; and also a red laburnum, but have failed in the expected results of their experiments. Some plants assume in cultivation almost endless tints—for example, the garden ranunculus is of all colors but a light blue, but it is by no means proved, nor even surmised, that such varieties depend upon the absorption of any particular ingredient.

132—*Requested the method of French Polishing?* See page 370.

133—*What kind of Chalk will mark clearly upon Glass?* No material will mark clearly upon glass, unless it be either greasy or sugary; perhaps, for such a purpose, lithographic chalk might answer, if not, a chalk might be make of lamp-black, treacle, and gum water. Those artists who write, or gild upon glass, sketch out the design first with a pointed piece of tallow.

140—*How are Magnets made?* See pages 348, and 373.

141—*How is Brass Bronzed?* See page 398.

142—*If a Plummet be suspended over the side of a Mountain, would it be attracted out of its perpendicularity?* Certainly, in proportion to the mass of the mountain, and the square root of the plummet's distance from it. This was tried and proved by Dr. Maskelyne.

151—*What is Madder Carmine, and how prepared?* Madder carmine is a pigment prepared from a plant of that name. For the following process of making it, the Society of Arts voted Sir R. Engerfield their gold medal. Inclose 2 ounces troy of the finest Dutch crop madder in a bag of fine and strong calico, large enough to hold three or four times as much. Put it into a large marble or porcelain mortar, and pour on it a pint of clean, soft water, *cold*. Press the bag in every direction, and pound and rub it about with a pestle as much as can be done without tearing it, and when the water is loaded with color pour it off. Repeat this process till the water comes off but slightly tinged, for which about 5 pints will be sufficient. Heat all the liquor in an earthen or silver vessel till it is nearly boiling, and then pour it into a large basin, into which a troy ounce of alum has been previously put. Stir the mixture together, and while stirring, pour in gently about $1\frac{1}{2}$ ounce of a saturated solution of potash. Let it stand till cold to settle; pour off the clear yellow liquor, add to the precipitate a quart of boiling soft water, stirring it well, and when cold separate, by filtration, the carmine, which is $\frac{1}{2}$ an ounce. If less alum be employed the color will be somewhat deeper; with less than $\frac{3}{4}$ of an ounce, the whole of the coloring matter will not unite with the alumina. Fresh madder root is equal, if not superior, to the dry.

152—*What Threshing Machine is applicable to Clover Seed?* The best threshing machine is decidedly that of Mr. Meikle; it is worked by two horses, and is the kind universally adopted in Scotland, and the north of England.

154—*How is Rice Paper made, and of what?* Answered on page 367.

155—*How are Steel Pens Browned or Bronzed?* By dipping them into the liquid mentioned in page 398, and afterwards heating them gradually and evenly.

156—*Why does Friction produce Free Electricity?* The same general answer given to Query 47 is applicable to this also, for we can only say, that such is the nature of the electric fluid; but why it be so is unknown.

159—*How can Glass Windows be rendered semi-Opaque, and how made to appear Crystallized?* *1st method.*—Make some common paste, color it if you please, and brush it over the windows, finishing it by dabbing it all over with the ends of the hairs of the brush. Water will wash it off at any time.

2nd method.—Take a piece of common putty, and dab it repeatedly on the glass till the effect is produced; turpentine will clean it off: or the windows may be painted with any oil or varnish color.

3rd method.—Wash the glass over with a brush dipped in fluoric acid; this will instantly corrode the glass.

4th method.—Rub the panes of glass over with fine emery powder and water, by means of a smooth cork. Figures or ornaments, if painted on this ground glass, with Canada balsam, will be transparent, while the rest remains semi-opaque.

5th method.—Make a strong solution of Epsom salts in vinegar, and apply the same to glass with a large camel's-hair pencil; in a short time the salt will crystallize, which will present a beautiful appearance; this may be rendered permanent, even in a damp place, by giving the glass a coat of white varnish. If you wish to imitate stained glass, grind with a little spirits of turpentine, for blue, Prussian blue; for red, lake; &c. &c.; mix this well with the above varnish, which will give the crystallization a very pretty effect. Almost any other salt may be used, instead of the above, as for example, sal ammoniac, Glauber's salts, &c. A saturated solution of spirits of wine and camphor is also occasionally employed. Water will remove any of the preparations.

163—*How is Wire to be covered with Silk or Cotton?* See page 369.

166—*How can Oil Paintings be transferred to New Canvas?* Answered on page 411.

169—*How is Gilding on Glass performed, such as is sometimes seen in the chemists' windows?* By merely applying first to the glass a coat of gold size, according to the shape or figure you wish to represent; then allowing it nearly to dry, some fine gold leaf must be applied.

Another method.—Moisten the surface of the part to be gilded with gin; then float on the gold leaf and hold the opposite side of the glass to the fire; the spirit will evaporate, and the gold will be smoothly attached to the glass; then paint those parts of the gold you wish to remain, and when this is dry wash off the rest.

170—*Why do Candles become white by storing, and also have their illuminating power increased thereby?* Is their illuminating power increased thereby? I trow not! all oily, fatty substances give the best and purest light when fresh and new, simply because they are then pure.—A COR.

172—*What will soften hard Putty?* Soft soap applied to the putty and allowed to remain on about one hour.

173—*How is Wood prepared for the Wood-Engraver?* The box (the only wood used, except pear tree for common purposes,) is cut into transverse sections of exactly one inch in thickness, and then planed upon the surface, so as to be perfectly smooth —no other preparation is necessary; it may, if more convenient, be reduced to a perfect surface in the lathe.

176—*Can Ventriloquism be acquired, and if so, how?* Answered on page 396.

177—*How is Paper, &c. Embossed?* By being first damped, and then passed between engraved rollers, or else in a press between two dies. Embossing of all kinds is similarly executed.

178—*What is the Ground Nut, and how can its Oil be extracted?* The ground nut is the produce of a South American leguminous plant, called *Arachis hypogæa*, whose pods have the peculiar property of forcing themselves into the ground while ripening their seeds; hence called earth nuts. They are of a whitish color, and of an oblong form, are of frequent sale at the grocers in London, and will grow well in the hot-house. The oil is extracted by simple pressure assisted by heat.

179—*How is Black-Lead prepared for Pencils?* The best pencils are made of Cumberland black-lead, sawed up into long strips, and glued into the channels prepared for them. Other kinds are made by mixing powdered black-lead with size, and squeezing this paste into the wood; the quantity of size being in proportion to the degree of hardness required. The very commonest pencils, such as the Jews are so famous for making, are filled with a mixture of black-lead and sulphur melted together. Shell-lac melted and mixed with black-lead, when in a melted state, forms excellent pencils, particularly hard pencils. According to the proportionate quantity of shell-lac, so will be the degree of hardness of them.

181—*How does Nitrate of Soda act as a manure, and what quantity per acre is most beneficial?* Its action, as well as that of nitrate of potass, or saltpetre, is probably the dissolving various matters in the soil, which a sickly crop cannot sufficiently do, thus rendering them more easy to be absorbed by the roots. It answers no good purpose when applied to vigorous crops, but much assists those which are sickly; particularly wheat crops; and these only will warrant the expense. It is used in the quantity of from half a hundred weight to two hundred weight per acre; its best application appears to be as a top dressing, sowing it broad-cast, while the wheat is young and in blade.

182—*How are Stencilled Letters made?* Thin sheets of hardened brass have the letters drawn upon them by hand, or else by another stencil plate, and then they are cut out with the point of a knife, laying the plate to be operated upon either on a piece of smooth wood or a sheet of lead.

183—*What Metal is fit for Parabolic Mirrors?* Those given as specula metal, page 236.

184—*With what are the Letters on Door Plates filled so as to be hard and durable?* Nothing is so good for this purpose as common black sealing wax. Heat the plate, rub in the wax, and, when quite cold, clean the whole off smooth with a flat bung and emery powder or paper.

QUERIES 135, 149, 150, 164, 167, 168, 171, 174, 175, and 180 are unavoidably transferred to Volume II

INDEX

TO THE FIRST EDITION.

Reference to the Queries is given according to the subject of them, those unanswered being alone omitted. If it be desired to ascertain the Number in which any particular Article may be found, divide the page given by 8—if nothing remain, the quotient shows the Number sought after—if there be a remainder left after the division, add one to the quotient figures.

INDEX

OF ARTICLES ADDED IN THE SECOND EDITION.

END OF THE FIRST VOLUME.

D. FRANCIS, ... HORSE LANE, MILE END ROAD.